THE ROLE OF UNIVERSITY-INDUSTRY-GOVERNMENT RELATIONSHIP IN CLUSTER DEVELOPMENT: THE CASE OF MSC MALAYSIA

By

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DECLARATION

This thesis is submitted in fulfilment of requirement for the degree of Doctor of Philosophy (Management) at the University of Stirling, Scotland, United Kingdom (UK). I declare that this piece of work is based on my original work except for quotations and citations which I have duly acknowledged. I also declare that this thesis has not previously or concurrently submitted, either in whole or part, for any other qualification at the University of Stirling or other institutions. I am responsible for any errors and omission present in this thesis.

Signed

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ABSTRACT

Malaysia is a transition economic country that aims to be a developed country by 2020. In realising this mission (Vision 2020), the cluster concept has been an interest and adopted by the central authorities. There are few years ahead to reach the targeted year and it interest of this study to investigate the relevant development on its own engineered cluster of the Multimedia Super Corridor (MSC) that was put forward on the success of Silicon Valley in the US.

This thesis focuses on the development of the MSC cluster in the Malaysia context. It examines and measures the state of the cluster, the role played by its core actors (from Triple Helix perspective) and their relationship in the MSC. The role of collaboration has been used to measure the relationship among actors with the key determinants of cluster formation. A mixed data collection method was used to answer the research question and objectives involved. A conceptual model for analysing the MSC cluster is proposed, bringing together insights from the literature on clusters, role of actors, collaborative relationship and the complex systems of innovation approach. This conceptual model uncover the weaknesses of social dimension (social infrastructure) in Porter’s diamond model and the general approach of Triple Helix model in the cluster development. The cluster lifecycle model is used to add the depth to the analysis on the condition of cluster development.

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LIST OF ABBREVIATION

3WC	World Wide Web Consortium
BioCorp	Biotechnology Corporation Sdn. Bhd.
BIOTEK	National Biotechnology Division
BoG	Bill of Guarantee
CEO	Chief Executive Officer
CPI	Consumer Perception Index
DAP	Democratic Action Party
DBIS	Department for Business, Innovation and Skills (United Kingdom)
DTI	Department of Trade and Industry (United Kingdom)
DVP	Deputy Vice Chancellor
ECER	East Coast Economic Region
EPU	Economic Planning Unit
ETP	Economic Transformation Programme
EU	Research University
E.U	European Union
FDI	Foreign Direct Investment
GDP	Growth Domestic Product
GTP	Government Transformation Programme
HTBF	High Technology Small Firms
ICT	Information Communication Technology
IHL	Institute of Higher Learning
IP	Intellectual Property
IT	Information Technology
JC-GEMS	Job Camp-Graduate Employability Management Scheme
KL	Kuala Lumpur
KLIA	Kuala Lumpur International Airport
KPI	Key Performance Indicator
MACA	Malaysia Anti-Corruption Agency
MCA	Malaysian Chinese Association
MATRADE	Malaysia External Trade Development Corporation

MDeC	Multimedia Development Corporation
MeSH	Mobility, embedded software & hardware
MIC	Malaysian Indian Congress
MIDA	Malaysian Investment Development Authority
MITI	Ministry of International Trade and Industry
MMU	Multimedia University
MNC	Multinational Corporation
MOHE	Ministry of Higher Education
MOSTI	Ministry of Science, Technology and Innovation
MoU	Memorandum of Understanding
MSC	Multimedia Super Corridor
NCER	Northern Corridor Economic Region
NDP	National Development Policy
NEAC	National Economic Action Council
NEM	New Economic Model
NEP	New Economic Policy
NERP	National Economic Recovery Plan
NF	National Front
NIE	Newly Industrialised Economy
NIS	National System of Innovation
NKEA	National Key Economic Areas
NSDC	National SME Development Council
NVP	National Vision Policy
OECD	Organisation for Economic Co-operation and Development
OPP1	First Outline Perspective Plan
PAS	Pan-Malaysian Islamic Party
PASW	Predictive Analytics Software
PETRONAS	Petroliam Nasional Berhad
Phd	Doctor of Philosophy
PKR	Parti Keadilan Rakyat
R&D	Research and Development
RM	Ringgit Malaysia

RU	Research University
S&T	Science and Technology
SCORE	Sarawak Corridor Renewable Energy
SDC	Sabah Development Corridor
SME	Small and Medium sized Enterprises
SME Corp	Small and Medium Enterprise Corporation of Malaysia
TPM	Technology Park Malaysia
UGRAD	Undergraduate Apprenticeship and Development Programme
UIG	University Industry Government
UITM	Universiti Teknologi MARA
UK	United Kingdom
UKM	Universiti Kebangsaan Malaysia
UM	University Malaya
UMNO	United Malays National Organisation
UN	United Nations
UNIKL	University Kula Lumpur
UNITEN	Universiti Tenaga Malaysia
UPM	Universiti Putra Malaysia
USA	United States of America
USD	United State Dollar
USM	Universiti Sains Malaysia
UTM	Universiti Teknologi Malaysia
UTP	Universiti Teknologi PETRONAS
WEF	World Economic Forum
WIPO	World Intellectual Property Organisation
VC	Vice Chancellor
V.C	Venture Capital

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The success of transferring public research to full commercialisation is dependent on various factors such as legislation, the economic environment and entrepreneurship, technical progress, and university strategies, Laperche (2002). This argument plays well into the more mainstream concept of the Triple Helix as espoused by Etzkowitz (2005) where there are interactions between universities, industry and state (Government). Etzkowitz highlighted knowledge capital as the most crucial factor in creating successful regional clusters. This study considers this Triple Helix model where it seeks to explore new configurations of institutional forces emerging from national innovation systems, especially from relationships between governments, industries and universities (Etzkowitz and Leyesdorff, 2000) in regional development strategies. An interesting view of the model by Stiglitz (2002) is the emphasis on the value of nurturing industries through the collaboration between universities, researchers, government departments, public officials and agencies to benefit the firms, sector and country through created knowledge transfer channels.

1.2 THE PURPOSE OF THIS STUDY

The purpose of this study is to use these established frameworks to investigate their relevance for regional development on an engineered cluster in Malaysia; the

Multimedia Super Corridor (MSC), situated south of Kuala Lumpur. This MSC cluster is an example of a green field attempt to create a functioning industrial cluster as a basic feature of the Malaysian government economic development policies since 1996.

1.3 RESEARCH QUESTION AND OBJECTIVES

This investigation seeks to answer the following research question:

> "What are the factor and institutional collaboration determinants for successful cluster development and how do they fit the engineered MSC Cluster?"

The objectives of this research are to:

1. Explore and investigate the factors (determinants) for the development of firms in a cluster.
2. Examine the factors that influence firm growth in the cluster: the collaboration effect including motives and barriers
3. Understand the nature and role of university, industry and government; and their relationship in cluster development (MSC Cluster).
4. Identify the primary determinant condition factors that make the MSC cluster different from organically formed clusters.

1.4 SIGNIFICANCE OF THIS STUDY

The concept of the industry cluster is widely regarded as one of the main tools for generating economic growth and competitive strategies of nations. This concept, popularised by Porter (1990), suggests that industry clusters promote the competitiveness of nations' industries through a set of active relationship between the respective clusters. The actors in such clusters include firms, universities, institutions and government play vital roles towards the success of the cluster along with its competitive strategies such as the need to innovate. Research done by Baptista and Swann (1998) found that firms located in strong clusters are more likely to innovate. This has led to the concept of industry cluster being adopted as one of the strategy for economic growth. However, it has also created challenges for developing countries that have adopted the strategy. These challenges are significant and often require the adopters to address the following questions in order to successfully overcome them:

(1) how significant is the cluster concept for developing country;

(2) how far and vital the actors in the cluster play their roles;

(3) what motivates firms locates themselves in the cluster;

(4) how crucial the process of cluster formation; and

(5) above all what types of challenges for policy maker to strengthening cluster formation and development especially for developing counties?

Currently, there are few documented success story of cluster formation from developing countries in the literature. Undoubtedly there will be those who will argue that there exist successful clusters such as that of Silicon Valley in the United States of America, the Cambridge Fen in the United Kingdom and the Sophia-Antropolis in France. However, these clusters have grown organically where it would not be preposterous to describe some of their growth and success as owing to some degree of luck and opportunity. What is lacking in the literature is a discussion of cluster formation from the perspective of developing nations where the clusters are specifically engineered. This study is designed to fill the gap in the literature and the results of the study could have significant impact on the understanding of the important role of actors and collaborative relationship for development of engineered clusters. It has to be noted that not all features are applicable or replicable in developing countries specifically due to cultural, political and economic differences, but, it is worth identifying and cultivating what works. Therefore, it is interesting to investigate and explore the developmental process of an engineered cluster such as the MSC in Malaysia. In addition, this study should contribute to policy making for regional development in developing countries by providing a planning framework of the key issues contributing to the success of an engineered cluster in developing countries.

1.5 STRUCTURE OF THE STUDY

This thesis is structured in nine different chapters. Continuing from this introductory chapter, Chapter Two presents discussion around the issues related to the importance of innovation for technological change and the management of such innovation. The chapter provides an overview of cluster concepts focusing on the topical area of innovation with an emphasis on the determinants and factors behind the phenomenon, including the role of technology based firms, the role of government and universities in economic development.

Chapter Three discusses the relevant concepts and theoretical underpinning of this research in order to enhance the understanding of cluster formation. The discussions here present a review of relevant literatures within the confine of cluster formation. Particular attention is paid to the literatures on national system of innovation; triple-helix; Porter's diamond model; and finally business network model. A conceptual model is finally developed and presented in order to provide a framework for this research.

While the next chapter, Chapter Four, focuses on framing Malaysia as a case study. The substance of the discussion here take on brief discussion of Malaysia's historical and current economic development; the National System of Innovation (NSI) guiding the trajectory of this development with present the role of government, universities and technology firms; and finally identifying central government initiatives to develop the country.

Chapter Five is more practical in its approach which presents the methods used in order to address the issues raised from the research questions identified in Chapter One. The chapter also present and discuss relevant research tools and methods available whilst at the same time channelling the discussion towards the most appropriate methodology and data gathering techniques.

Chapter Six present findings from the quantitative data collected from the questionnaire survey of MSC and Biotech companies. The discussions of this chapter include statistical analysis of the findings and the reliability of variables within the questionnaire. An influence diagram is also presented as the summary to illustrate the findings of the survey and enhance the understanding and meaning of the data to this research.

Chapter Seven presents the qualitative aspect of the findings of this research. The discussion in this chapter takes on presenting the narrative of the 21 semi structured face-to-face interviews conducted in Malaysia. This chapter further explained the protocols and process of the qualitative data analysis. Also, influence diagram was used to summarise the qualitative data.

Chapter Eight incorporated the findings from the quantitative and qualitative method in Chapter Six and Seven respectively in order to present a coherent discussion of the findings. Central to the theme within Chapter Eight is to summarise and draw conclusions on the findings of the survey and in-depth interviews; discuss their implications and limitations of this study; and finally make suggestions for further research.

Chapter Nine presents the critical reflection from the research findings and discussion. This chapter concludes the thesis by: (1) summarising the research findings; (2) discussing the contribution from theoretical and practical perspectives; and (3) presenting the limitations of the research. Recommendation for future research is also presented.

CHAPTER TWO

INNOVATION AND INDUSTRIAL CLUSTERS

2.1 INTRODUCTION

This chapter presents a discussion of the issues on the importance of innovation for technological change and the management of innovation. The application of cluster concepts in innovation are also discussed with emphasis on the determinants and factors behind the phenomenon, including the role of technology based firms, the role of government and universities in economic development.

2.2 INNOVATION: AN OVERVIEW

Innovation can be defined as an important tool in today's business environment. While a more conventional definition of innovation can be found in various academic journals. According to Schumpeter (1961), entrepreneurs are the driver of economic development and they do this by what is described as:

> *"carrying out new combinations".* (Schumpeter, 1961: 132)

This notion of carrying out new combinations is where entrepreneurs introduce innovation as a new invention or new process. By virtue of this view, it can be considered that from an economic perspective, Schumpeter (1961) defined innovation as new combinations of concepts by introducing new good, new method of production, new type of market, new resources and new organisation in the industry. In turn, all of these factors exist to satisfy human want. Rogers (1983) refers to innovation as adopting new ideas to the organisation while Freeman (1983) defined innovation as offering new products or services through the use of new knowledge that meets consumers' need. For the purpose of this thesis, the definition of innovation shall take on the perspectives put forth by Schumpeter (1934) where innovation is referred to as five different aspects:

1. The introduction of new products or services
2. The introduction of new methods
3. The opening of new markets
4. The use of new supply sources
5. The restructuring of industry through new competition

Therefore, to remain competitive in the market, the ability to change and innovate by applying these five factors is very important. Porter (1990) suggested that by introducing new technologies and new ways of doing things, companies could achieve competitive advantage.

2.2.1 The importance of innovation

Many multinational corporations (MNCs) such as Microsoft, IBM and Apple Inc. have incorporated innovation as one of the core elements in their business practice as it is widely seen as an important factor in ensuring success and continued growth of business organisations (Thompson, 2011). These MNCs found constant innovation is required in order to remain competitive especially in the fast evolving computer hardware and software industries. Companies like Google, for example, incorporate innovation into its organisational culture (Kotler et al, 2008). A classic example is that offered by Apple Inc., where this company took the risk of introducing initially the iPod and later the iPhone as part of their product offering in order to overcome their flagging computer sales. Both products were not essentially innovative in their hardware form as it took a cue from the likes of other MP3 and smartphone which were already circulating in the market at the time. What was innovative about the offering was that both products made use of innovative content in the form of the iTunes store. This was the missing link and marked Apple Inc. out from other offerings at the time. What further compounded the success of both products was the way in which it was designed and marketed. Innovation certainly helped companies to develop new product(s) as it is unpredictable to know and understand what people want, believe and their attitude towards new things. However, as Apple Inc. has gone on to prove, clever marketing and cleverly designed products can help keep the company stay ahead of its competitors.

It is always risky when companies decided to embark on new product or service development in the market. It is known that entrepreneurs are risk taker and see the opportunity to make, create or change things for the better, to be more creative, practical and profitable. Innovation can be regarded as a process of utilising and/or transforming new ideas into useful practices (DTI, 1994; Tidd and Bessant, 2009). Innovation is said to be one of the crucial components in the entrepreneurial process. As commented by Kirby (2003), who found that how crucial it is depends on how it is used and managed. This is essentially because innovation is the specific tools of entrepreneurs, the means by which they exploit change as an opportunity for different businesses or different services (Drucker, 1985). In later work, Drucker (2006) put forth the notion that meaningful innovation is dependent on research and analysis, on organised methodical review and assessment, and on rigorous efforts by people as well as how organisations can adapt and learn.

It can also be further argued that innovation not only matters for new product development and/or services, for market performance and entrepreneurs, but that it can also be regarded as important at a regional and national level. This is where innovation policies are often developed in order to spur the economy. Many countries such as China, Japan, Malaysia, the United Kingdom (UK) and the United States of America (USA), to name a few, have identified innovation as one of their main factors employed to influence, interact, stimulate and direct the technological innovations in their countries. The central idea behind this is the view that innovation can influence the development of the economy. The UK, for example, having experienced crisis in the financial sector, deemed fit to launch a new national strategy called 'Going for Growth' which was introduced by the Department for Business Innovation & Skills in January 2010. This strategy outlined plans for sustaining recovery from the current economic climate. One of the key areas focused on the strategy whereby encouraging skills growth can nurture and develop highly skilled labour and can also fill the skill gap for New Industry, New Job(s) for Britain (DBIS, 2010). Another example is China, which introduced the 'International Traditional Chinese Medicine Program for Cooperation Science and Technology' in 2006 as one of its national innovation strategies. The strategy was to incorporate modern and traditional medicine practises to develop and promotes traditional medicines for its people's health and share worldwide.

The growth of cutting edge technologies gave rise to challenges for researchers, scientists, policy makers and entrepreneurs in order for them to continuously innovate and be ahead of their competitors. The internet as one of source for knowledge sharing has helped many to keep up-to-date with new technologies. It also gave rise to challenges for online business no matter how big or small size of the business. The main things is that, in order to remain competitive and grow in the current economic climate, the competitive advantage needs to be grown and to do so one needs to regularly innovate. This does not mean only for products or services, whether they are radical or incremental to innovation but also the processes or designs and the market itself (Johne, 1999).

2.2.2 Managing innovation

The introduction of science and technology can be regarded as a vital ingredient for companies or organisations in their process of innovation (Dodgson, 2000; Trott, 2008). Innovation can also be understood by its importance and the way it is managed. It is interesting to note that some authors such as McCaffrey (2009), Mises (1966) and Rothbard (2004) put forth the view that innovations are very difficult to predict and therefore makes it very difficult for governments to plan and manage. Other authors, such as Bessant et al (2005), Lundvall (1992) and Trott (2008) suggest that innovation can be managed at both micro and macro levels.

It is worth noting that Rothbard (2004: 961) presented an opposing view of planned or managed innovation where it was described as:

> *"Inventions, innovations, technological developments, by their very nature, by definition, cannot be predicted in advance and therefore cannot be centrally and bureaucratically planned. Not only does no one know what will be invented when; no one knows who will do the inventing . . . bureaucracy, incompetent enough to plan a stationary system, is vastly more incompetent at planning a progressive one".*

This is a throwback to the Schumpaterian entrepreneurial theory as it essentially points to the fact that humans and their forecasting ability are subject to error. McCaffrey (2009) also questioned Schumpeter's 'assumption' made by where Schumpeter asserts that progress or innovation is a matter of routine. The point made by McCaffrey that contradicts Schumpeter relates mainly to the notion that any plans are tentative and are therefore subject to error. Notwithstanding that, McCaffrey also argues that to make progress a matter of routine would require constant accuracy in entrepreneurial forecasting, something that is assumed by Schumpeter's entrepreneurial theory, but which is simply quite impossible to achieve under constant threat of error in human action.

From the organisational perspective, innovation can be managed and it is not only about the product or services, it consists of every factors which relates to successful organisation such as the internal and external environment, culture, the national policy on innovation, the intellectual property issue, the capability of its research and technology, and of course the financial availability. Therefore, to achieve effective innovation management, it is important not just to prioritise one aspect (but many). For example, managing the design of the product and/or services, but also being able to manage the internal system of innovation with all its complexity (Bessant et al., 2005). Building an innovative organisation is also sensitive to the culture of the company. O'Brien and Smith (1995) suggest that organisation(s) that are encouraging and provide innovative culture environment could help increase their innovative capabilities and possibility to earn more profits (Shaohang, Jianjun and Qiulan; 2011) than other organisations that are not.

The conceptual framework of innovation put forth by Trott (2008) shows that innovation is a management process where its functions interact internally and externally with the environment (Figure 2.1). Company based entrepreneurs, scientists and engineers regularly communicate with other scientists/technologists from universities and institutions on developments in science and technology. Marketing functions interact with suppliers, competitors and customers to find out what the market need. The top management also interact and communicates with other organisations for example, government agencies regarding policy and financial support. As a result, the information flow from these interactions gives valuable knowledge to all the functions in the organisation (and helps them) to recognise, capture and utilise it and develop a successful new product and/or services.

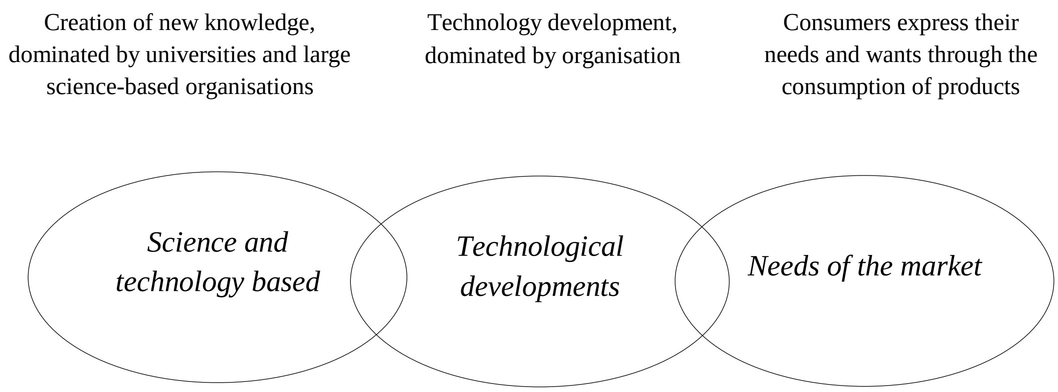


Figure 2.1: Conceptual framework of innovation by Paul Trott (2008)

2.2.3 Innovation System

The previous section recognises the importance of effective innovation management and the organisational challenges inherent in the process. These challenges are partially dependent on the nature of the business and institution organisations, the business environment, and the way they approach technological innovation (Dodgson, 2000). Thus, technological development cannot be viewed as a well-focused activity nor approached through a single context, but in the wider environment that forms the immediate innovation systems (i.e. national, regional, sectorial and/or technological system of innovation).

According to Edquist (1997), increased interest on studying the concepts of systems of innovation started in early 1990s with work by Freeman (1987), Lundvall (1992) and Nelson (1993) on national systems of innovation (NIS), followed by Carlsson (1995) on technological systems; and later Cooke (1996) from the perspective of regional systems.

This evolution of the boundaries of the "innovation system" has refined understanding of the concept through investigations of various industry scopes, case studies and functions. Despite each system having a different emphasis, an appreciation of the various system mechanisms is essential to understanding and investigating the dynamics of innovation activities in context. This ability to manage the complexity of operationalizing the concept of innovation processes reduces risks when attempting to design an innovation system able to create, incubate, develop, diffuse and utilise knowledge for innovation and competitiveness (Lundvall, 1992 and Carlsson et al., 2002). Innovation systems represent a rich combination of innovation activities in the local innovative milieu; supporting policies, interaction and network linkages (Cooke, 2001) of participating system actors, such as institutions (universities), firms (industries) and government.

The geographical perspective (Carlsson et al., 2002) of specific physically boundaries at the nation or country level are classed as national level systems (NIS). The NIS concentrates on national local factors, interaction of system actors and how the nation learns in their unique practices and culture (Freeman, 1987; Lundvall, 1992; Nelson and Rosenberg, 1993; Patel and Pavitt, 1994; and Bryant et al., 1996). Further to this, Porter (1990) discussed the importance of national determinants and characteristics influence on competitive industries and individual firms. For example, "home demand conditions" such as the size, pattern of growth and supporting policies can reinforce each other to form unique development paths for informed local firms. Both concepts of NIS and Porter's competitiveness are further discussed in Chapter 3 as part of main theoretical concept used for the development of conceptual model of this research.

The regional aspect were later added in the NIS literature as a subnational boundary system (Edquist, 1997) to investigate the complexity of innovation systems that are geographically or regionally (spatially) distinct. The analysis of regional innovation system highlighted the role of geographic proximity of firms with local system institutions such as universities, suppliers and government agencies that influence the competitiveness of individual organisations (Cooke, 1996). Related studies by Saxenian (1994) investigated the "regional industrial systems" of Silicon Valley and Route 128, with Marshall's (1930) concept of "industrial districts". The regional concept highlights the benefits of proximity for successful economic agglomeration (cluster) and high impact on specialism of local learning, interaction, networking and collaboration throughout the local milieu (Cooke and Morgan, 1994); which create its own unique identity over time. For instance, the closeness of individual firms and/or organisations with knowledge and research institutions i.e. universities provide opportunities in collaborative innovation arrangements (such as joint-research projects, utilisation of facilities and equipment, consultancies, and trainings) facilitates a rich transfer of knowledge. This is noted for enhancing the absorptive capacity (Cohen and Levinthal, 1990) of individual organisations (firms, universities or institutions) on knowledge and learning for innovation through its networking practices, opportunities for knowledge density spill-over, and enhances the closeness or trust based relationships.

A key component of a regional innovation system is the role of the regional government and its policies, especially those known to accelerate innovation activities in companies, such as financial aid (Cooke et al., 1997). This is based on the importance of a deeper understanding and vested interest in the regional situation from local regional policy developers and advisors. Local knowledge facilitates a greater awareness of the connective mechanisms, local factors and competences to enable informed planning and implementation of supporting policies for the regional development. The local government or public sector interventions are necessary to influence regional growth and lower the risk of system and market failure (Saxenian, 1994; Cooke and Morgan, 1994; Cooke, 2001). Therefore, the issues of closeness of proximity benefit the degree of trust and relationship formation (formal and informal interaction) among firms (industries) and institutions (universities, agencies, and/or public sectors) that can influence the knowledge density spill-over.

A different, but related, the sectorial approach on perspectives of innovation systems contrasts those of the geographical boundary systems (national and regional system). The "sectorial system of innovation" focused on innovation in specific sectors (industry) or technology. Carlsson's (1995) early studies on Swedish technological systems, such as pharmaceutical, electronics and computers formed the term "technological system" and highlighted its distinct features (Carlsson and Stankiewicz, 1995) based on the characteristics of specific technology including the organisations (firms and institutions), learning and interaction bounded within the system's components and relationships (Carlsson et al., 2002). These relationships evolve over time to enhance innovative capabilities that are not necessarily within the boundaries of a national or regional level. Hence, the sectorial or technological system combines the geographical and sector or technology elements and functions of specific system actors, economic areas, networks and interaction. This is an assumption that sectorial systems of innovation overlap NIS (Malerba, 2002) and are very similar to Porter's (1990) concept of clustering for competitiveness.

Development of cluster studies can be and must be related to the understanding of innovation systems; in particular the regional approach. The innovation system involves the characteristic of system actors (firms and institutions) and influenced by the behaviour and capabilities of learning, networks and interaction within or beyond local milieu boundaries for innovation.

2.3 INDUSTRIAL CLUSTERS AS AN ENGINE OF INNOVATION

Paytas et al (2004) discussed cluster development from three perspectives: (1) industrial policy; (2) technology policy and (3) regional policy. It was argued that these three elements have been included in most countries' technology based economic development programme and that there exists an overlap between industrial and technology policies. As such, it can be deduced that cluster theory occupies the middle ground between the three elements identified here where industrial policy seeks to improve performance of a specific sector of the economy (Storper, 1995) while technology policy promotes the advancement and diffusion of knowledge and innovation (Storper, 1995; Best 2001). Regional policy on the other hand aims to develop the economy or improve the socio-economic condition of a specifically geographically-targeted place (Paytas et al, 2004). It was further noted that:

> *"Cluster policy is a hybrid of these domains, over which no level of government has clear authority or responsibility (much like regional policy), which provides both opportunity and challenge."* (Paytas et al, 2004: 3)

It is therefore crucial to understand the concept of the industrial cluster as it may impinge on the success or failure of regional or national level policies. According to Simmie and Sennett (1999), the development of the cluster concept was theoretically debated during the 1990s where the focus then was on the conditions related to regional economic growth. However, the conceptualisation of cluster theory can be traced back to Alfred Marshall's (1930) earlier work on industrial districts where it was observed that the economic activity is often clustered in the same locations resulting in what was then described as agglomeration economies. Marshall believed that the industrial district concept could rescue the British economy during early 19th century (Belussi and Caldari, 2009). Industrial districts, according to Marshall (1930), are where local buyer and supplier have strong links, long-term contracts and commitments, and low links with firms beyond these districts. Adding to this, Schumpeter (1939) described the concept of cluster from the economic perspectives as a combination of 'new' things such as, methods, product or design, or process which could stimulate the innovation and continuous economic development and also where entrepreneur plays a disruptive role in creating products. This view was further supported by Enright (1995), who stressed the point that industry clustering in regional development was to foster or react to innovation of firms where they strive to be competitive. Porter (1990) also noted (this) in his Diamond Model which attempts to explain the clustering of a nation's competitive industries. Porter (1998) further explained that the cluster is a geographic concentration of competing, complementary or interdependent firms and institution(s) in specific fields which are dynamic and important to competition across national, international and regional boundaries. However, Oakey and Cooper (1989) stated that the agglomerated or clustered formation of high technology firms is due to input material and labour advantages as well as the locations in their studies of high technology firms in South East England, Scotland and the Bay Area of California.

It is not surprising to see works such as that by Saxenian (1985) which found that the success of Silicon Valley in California is often associated with the concept of industrial clustering. Since then, many nations especially from developing countries including, Malaysia, Indonesia, Thailand and China have adopted the concept to help generate the competitiveness of the industries as well as for economic regional development purposes. Therefore, the concept of cluster is akin to a geographic concentration of firms and related institutions in specific and interrelated fields where they exhibit the following traits: (1) strong relationship between the actors; (2) share common knowledge and culture; (3) demonstrate or share unique and dynamic competition which then promotes innovativeness; and (4) have a continuous economic development agenda either in global, national, and/or regional boundaries. These can be summarised as determinants for cluster formation which can be either for economic or social purposes (or both in some instances) where the process itself promotes the competitive activities and innovation process.

2.3.1 The Effect of Clustering

Clustering can be understood by its various definitions as either for economic or sociological purposes or both. Krugman (1998) claims that clustering concept or localisation shapes economic geography and in time also changes the spatial structure and economic growth. The effect for clustering includes the labour market demand, better access of information and interaction among actors such as firms, institutions and government, save transaction costs, common interests and needs, unique infrastructures and also promotes and motivates competitiveness and innovativeness among actors and also any economy of scales. The best example is Silicon Valley in the United States which took at least 30 years to be recognized as a successful cluster in high technology industry such as the semiconductor and biotechnology industries. Their success has changed economic development in California with novel technologies and has produced highly skilled entrepreneurs and labour. As the demand for specialised labour increases, clusters attract outsiders such as scientists, engineers and programmers to migrate because of the opportunities for better job positions and incomes. Subsequently, cluster pool skills labour in the area and drives labour to compete in designing or come out with something innovative or new. For example, Silicon Valley altogether has promoted many advanced technologies such as those currently in use in the computing and software industry, as well as other more niche technologies such as Satellite Navigation.

Social interaction between actors in a well-established cluster provides mutual understanding of interests, needs and knowledge. This means an improvement of communication between the actors within the cluster and better access to specialise talent and knowledge (Porter, 1998). The knowledge gathers from social interactions such as business networking and is more transferable and increases the trust element which is one of the main components in a cluster's culture (Etzkowitz, 2005; Cohen and Fields, 2000; Lyon, 2000; Cooke and Wills, 1999; Putnam, 1993). Thus this, in turn, promotes the competitive agenda between the actors in the cluster and enhances the productivity and innovative drive in order to survive and thrive in the highly competitive environment within the cluster boundaries.

2.3.2 Cluster Lifecycle

The functions of cluster can be understood from the processes of the cluster lifecycle i.e. the evolutionary development from emergence through the success stage to ultimate decline. Menzel and Fornhal (2010) proposed a cluster lifecycle of firm arrival and exit over time with five different stages (Figure 2.2). In their model, the stages of firm contribution to the cluster are developed and the interaction with other institutions in knowledge activities is also highlighted. According to them, the emerging phase was crucial as there were limited number of firms, thus support from government and local environment are necessary for firms to reach the critical mass so that the cluster can grow to the next phase. At growth phase, the firms further collaborate with other institutions to access more knowledge as the learning process becomes important for the technological space and direction. At sustainment stage, the cluster was at equilibrium's state and has shaped its regional identity and environment. Renewal and adaption were necessary for cluster firms to stay competitive before declining cluster emerged. Strong network and government support can be effective for the cluster to be maintained before the ability to sustain and diversification is lost, thus the cluster will reach maturity.

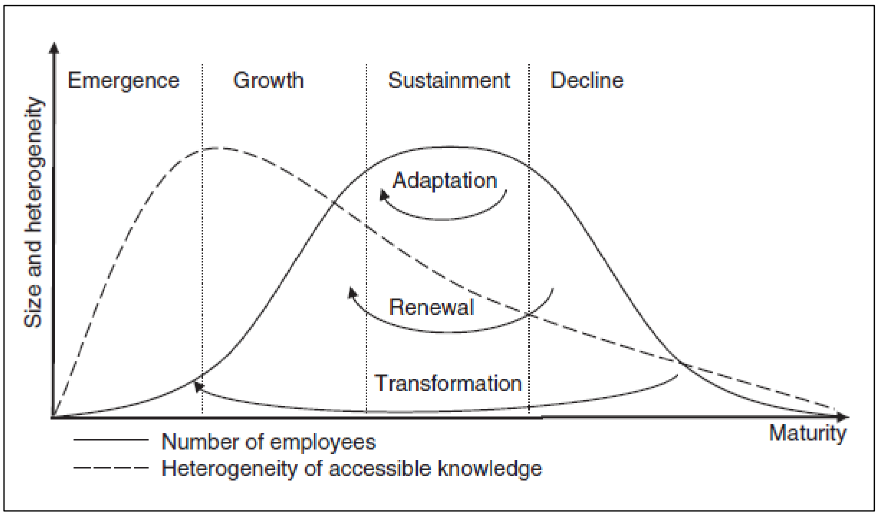


Figure 2.2: Cluster life cycle stage (Source: Menzel and Fornhal, 2010)

Prior to Menzel and Fornhal the UK DTI (2004) perceived clusters as dynamic and evolve through lifecycle stage. Theoretically, it can be said that the cluster lifecycle is akin to that of the product lifecycle, which has four main stages as shown in Figure 2.3. The first stage is the embryonic stage of the clusters which refer to those firms at the early stages of growth. The second stage is established clusters which refer to those firms perceived as having room for further improvement and growth. The third stage is the mature stage where those firms that are already established and stable and which are looking for further improvement but finding it difficult to grow. The fourth stage is declining clusters which refer to those firms that have reached their peak of success and are failing or declining. Clusters at the declining stage are sometimes able to reinvent themselves and enter the cycle again. This is where innovation comes into play again and offers another avenue for these clusters to re-enter the cycle (DTI, 2004; Tidd and

Bessant, 2009) and where innovation diffusion can be described as taking place (Trott, 2008).

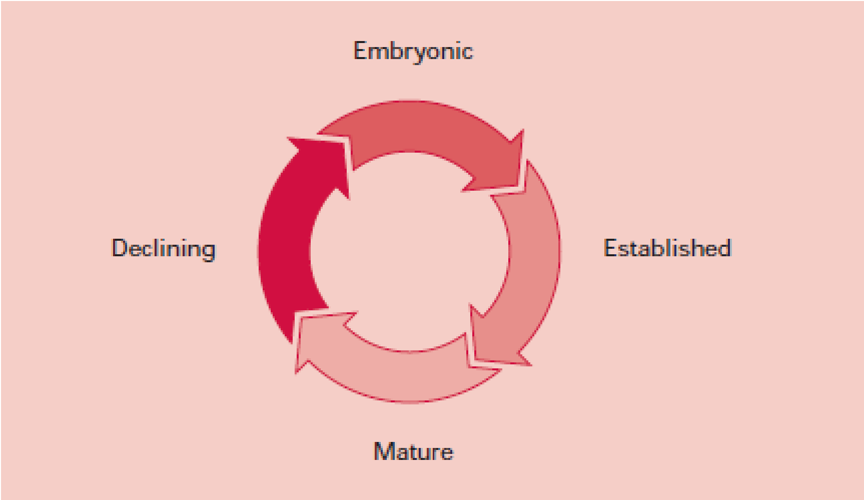


Figure 2.3: The stages of the cluster life-cycle (Source: DTI, 2004)

Both cluster lifecycle models have indicated that clusters evolve through time and have an ageing process (Martin and Sunley, 2011). However, both models contribute an understanding of the path and process of cluster development and they highlight the important aspects of conditions within the external environment in influencing the development of the industrial clusters. Menzel and Fornhal (2010) have suggested that the role of government, collaboration and inter-linkages between actors in a cluster could support the birth and progress of firms in the emergence phase encourages them to stay a little longer than expected in a declining phase.

2.3.3 Determinants of Cluster Development for High Technology-Based Industry

The evolution of Silicon Valley from relying solely on agriculture to high technology industry has been a benchmark to replicate the concept of regional clustering. However, it is worth noting that the emergence of Silicon Valley was unplanned and was organically grown (Saxenian, 1985). The triumph of Silicon Valley has drawn upon interest for emerging economies such as Malaysia to replicate the success story. Cambridge Fen in UK and Sophia-Antripolis in France are another two other examples of successful clusters in Information and Communication Technology (ICT) industry and biotechnology industry. DTI also has produced report on cluster and has listed critical success factors identified in global literature. Figure 2.4 displayed the related success factor.

<u>Indicators of a Successful Cluster</u>

In summary, the review of literature and an analysis of these three clusters indicate that there are eleven key determinants for the success of cluster formation and thus economic growth. This means the growth of technology based firms in the area (new company birth rate, company or university spin-offs and growth of established firms) is indicative of the economic growth in the cluster, and thus defines the contribution to the economic growth of the region. These determinants are:

1. *Close relationship with the actors in the cluster i.e. university, industry and government:*

   This represents an important aspect of social interaction and of working collaboratively between the university – industry – government in order to achieve a common goal or working with a special agenda such as profit maximisation, technology breakthrough, and self-recognition; which is mostly mentioned in the literature of regional cluster studies (DTI, 2004). The active inter-organisational relationship among the actors in industrial cluster (Saxenian, 1985 and 1994; Oprime et al., 2011) could stimulate the development of cluster as knowledge resources become vigorous for organisations to be competitive (Porter, 1998).

According to Etzkowitz (2008) the role of the actors such as universities, firms in the industry and government interconnecting with each other could support the regional development process from the *"knowledge, consensus and innovation spaces"*.

2. Local entrepreneurs and local skills:

Entrepreneurs play an important role in cluster formation regardless whether they are local or external entrepreneurs. The role begins when the decision to start firms is taken and by utilising the technology and market opportunity in order to create a new product or service that has economic potential. This refers to the contribution of local entrepreneurs in location development where they have easy access of local resources and networks (Feldman, 2001). This also means that for regional cluster, the local entrepreneurs (and some external entrepreneurs) facilitate the process and realisation of innovation (Feldman and Francis, 2006) and are therefore engines of economic growth. The organisational factors such as leadership and motivation of key entrepreneurs and leading skilled individuals in Silicon Valley and Cambridge also found that they played major important role in its success (Sturgeon, 2001; Feldman and Francis, 2006). However, the success of these two clusters is also due to the entrepreneurial environment that encourages the "risk-taker" attitude among firms or spin-off to build local champions without needing to relocate. This later turns the location into spatial economy of concentrated specialised individuals in related skills that resulted in the improvement of knowledge creation through the inter-organisation linkages (Maskell, 2001). Therefore, the role of entrepreneurs and skills are crucial for the development of regional industries and cluster.

3. Technology availability:

The availability of current technology to facilitate the progress of local technology firms in terms of the equipment, connectedness and telecommunications system use, software application, backup system and recovery software, and related materials and processes used to test the products or designs. For example, in Silicon Valley, the local technology has the dynamism with having the ability and capacity to produce indigenous technology which can reduce the transaction cost and which are easy to reach, (Saxenian, 1994 and Sturgeon, 2001) as it could have nowhere else to go. Above all, it related to the entrepreneurs and individuals by using their specialised skills for their business and R&D purposes in creating something new or innovative technology for the market (DTI, 2004).

4. Local financial support:

The role of financial institution and venture capitalist to support the local firm, especially the new firms, is another factor of great importance in the creation of cluster. This is made more difficult in the current economic climate where there exists this notion of limited funding and which the financial institution is reluctant to lend. However, in the case of Silicon Valley and Cambridge, local financial institutions including, public and private venture capitalist and public-private research partnership programmes, took the risk investing in young firms or spin-offs that have market potential and support them from financial stress which the source of finance was reachable (Ruang and Zang, 2009 and 2008; Etzkowitz, 2008; DTI, 2004; Sturgeon, 2001, Saxenian, 1999; Porter, 1998).

5. Location:

Physical locality and proximity with other firms has been cited by Porter (1990) as an important determinant in clustering phenomenon. Porter explained that clustering contributes to the advantages of location and includes concentrated entrepreneurial activities, functioning infrastructure and availability of human skills, technology, knowledge and financial resources that could foster the economic wealth generation. Furthermore, Etzkowitz (2008) believed that close proximity of the actors improve knowledge transfer activities and social bonding including, trust which is important for the university-industry-government collaborative relationship in entrepreneurial university culture.

6. *Research and development (R&D) activities:*

One of the key success factors of the Silicon Valley and Cambridge is the on-going R&D activities led by not only the industry but also collaborations with universities in the vicinity (Sturgeon, 2001; Oakey, 1991, Oakey et al, 1988). The R&D activities were also supported by the role of government in giving funds in terms of grant or research tax incentives to stimulate further regional growth and development (Johnston et al, 2008). The R&D is considered as one of the supporting mechanisms to facilitate and influence innovation among small technology firms (Devereux, 2003) and thus it is crucial for cluster development. The R&D also is the stage when technology firms are involved with the high learning and innovating process.

7. *Connection to market and commercialisation:*

Market connection is another important determinant in ensuring the success of the cluster. Through market connection, the commercialisation process becomes easier as familiarity with the right market would expedite the introduction of the product or services in the local or international market access (DTI, 2004). According to Chesbrough and Rosenbloom (2002), the factors in business model such as market value, value chain and network, marketing and competitive strategies are basic fundamentals that technology spin-offs need to understand so that the their technology or innovation discoveries are reachable and valued by the customers. However, Oakey et al (1993) also explained that lack of strategies and not enough financial resources during commercialisation process are among the reasons for the failure of small technology firms to continue and contribute in spatial economy. Bessant and Ross (1995) proposed that the roles of intermediaries are needed at this stage to connect the technology firms with the market by supporting the financial dilemma in the commercialisation process.

8. Issues on intellectual property right and patent:

The role of IP is extremely important as it addresses the fundamental issue of ownership and copyright of a particular technology. This will secure and protect the design, process or formula for young technology firms in particular. Folta et al (2006) in their research found that technology firms such as biotechnology are more likely to enter strategic alliance or collaborative work if they have patented their new idea, which at same time contributes to the growth of cluster size. The same results are also found in research by Calabrese et al (2000) with the Canadian biotechnology industry.

9. Government policy and its regulations:

Regulations and the role of government is an important aspect of the determinant. It continues on from IP and patent issues where the government needs to ensure not only an effective legal framework is in place but also ensures the effective implementation and enforcement of these legal frameworks. Porter (1990) argued that government policies in providing economic environment and support such as tax incentives for start-ups in selected industries and financial support like research grants could result in firms taking projects that have economical returns and thus increases the competitiveness of the region or nation. Solvell et al (2003) also reveals that the government's cluster initiatives in Europe could contribute the development of cluster through the birth of start-up following from the public-private partnership programme. This programme was also introduced in US in the early development of Silicon Valley, as claimed by Etzkowitz (2008).

10. Local culture including trust issues:

Different countries practice different culture and demonstrate different cultural traits. What is considered ethical in the Western world might be frowned upon in Asia. It is therefore an important facet in the understanding of the cluster success as not every factor that makes successful cluster such as that of the Silicon Valley can or should be replicated in other parts of the world. However, the social bonding between actors through inter-linkages of organisations and collaborative projects effect on the trust building (Porter, 1998) that share a sense of identity. Thus this make the cluster unique on its own interpretive and identity that firms can have better access of information and perform knowledge transfer activities much easier (Staber and Sautter, 2011).

11. Economic and business environment:

Porter (1990) argues that the competitive environment could influence the evolution of firms because the location is competitive with specialised services and products that require firms to innovate and come out with new ideas. The conditions of the location and which are healthy with active entrepreneurial activities and collaborations. Thus, this favours the market to offer something new that have economic opportunity. Solvell et al (2003) also describe that the social and political stability and the positive economic environment could also influence the performance or success of the cluster which gives it more confidence and trust to the new comers.

Theoretically, all of these determinants rely on each other to create an ideal and successful cluster supported by the role of university-industry-government relationships. The main question that falls on policy makers and researchers is how to develop cluster(s) and make the determinants work for developing countries that might lack some of these elements. Malaysia is one of the emerging economies that have embarked on a journey to re-create and emulate the success of clusters such as the Silicon Valley and Cambridge. The central idea behind Malaysia's push to recreate and emulate this success is to engineer its own industrial clusters.

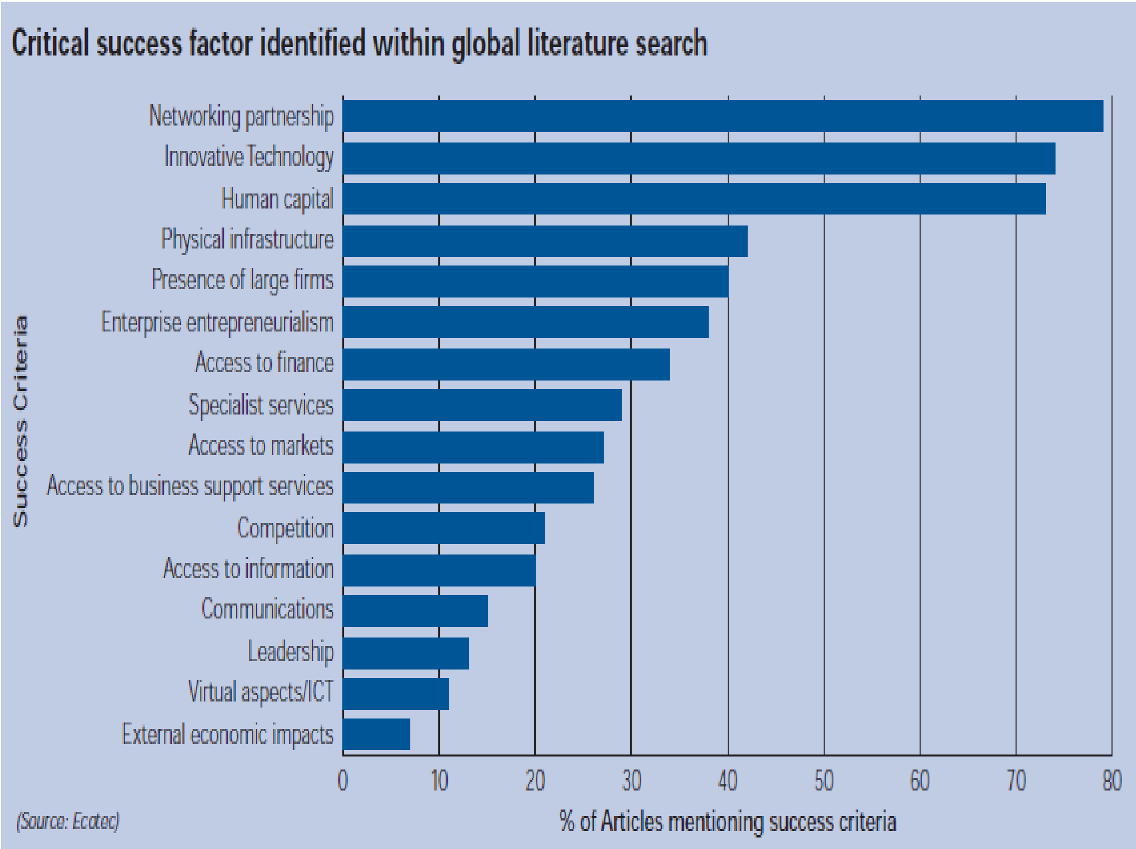


Figure 2.4: Critical success factors in cluster development (Source: Ecotec Research & Consulting in DTI, 2004)

2.3.4 High Technology-Based Firms and its Importance in Cluster

The success of Silicon Valley is associated with the growth of its high technology based firms (HTBFs). Firms that are involved in this kind of activity that is cutting-edge advanced technology, new and unique and which generally refers to high technology firms. However, the definition of high technology firms needs to be understood in order to better understand their relevance towards the success of clusters. To this extent, it is important to differentiate between firms that produce technology and those that intensively use technology. The definition of high technology based firm varies according to different scholars and it goes through changes and shifts over time. For instance, Jone-Evans and Westhead (1996) defined high technology based firms (HTBFs) as companies or firms that are technologically innovative in industry such as computer services; electrical and electronic data processing equipment; aerospace equipment; medical and surgical equipment; orthopaedic appliances; and telecommunications. The selected industry classified in Jone-Evans and Westhead (1996) does not include firms that are engaged in the biotechnology industry, which have been widely recognised by other authors as contributing towards innovative activity of high technology industry. Furthermore, their (Jone-Evans and Westhead, 1996) definition is more concentrated on 'product-based' rather than 'process-based' activity (Jones-Evans & Westhead, 1996; Oakey et al., 1990). Others like Keogh and Evans (1999) defined HTBFs in their research as firms whose principal activity falls onto one of five categories: engineering; software; instrumentation/electronics; analytical services; and biotechnology. However, Keogh and Evans (1998) research is limited for new HTBFs and focuses on 'process-based' rather than 'product-based' activity due to the small sample of their work which focused on 20 firms based in Aberdeen Science and Technology Park.

Referring to Organisation for Economic Co-operation and Development (OECD), HTBFs can be categorised as firms that are involved in high technology activity from nine selected sectors in aerospace, computers-office machines, electronics-telecommunications (includes information and communication technology – ICT), pharmacy (includes drugs & medicines), scientific instruments, electrical machinery, chemistry, non-electrical machinery; and armament (Hatzichronoglou, 1997). The OECD classification includes various aspects of technology diffusion (includes indirect intensity); uses R&D intensity as the main criterion of sector classification and applies two direct indicators, which are GDP purchasing power parities and R&D expenditure of countries participated to quantify the total R&D intensity. Using the OECD classification, the biotechnology activity is categorised under the pharmacy and it also classified in high technology sectors. The OECD sector classifications (from high, medium to low-technology based) is used by many economists and researchers from OECD's member and non-members, and also from the European Union as a tool for international comparisons (Hatzichronoglou, 1997). The OECD classification also has its limitations where the data used is only from manufacturing industry and not from services industry as there were not enough detailed data available. However, the classification will fit to services industry once the data is obtained. To that purpose, this research will use the OECD's high technology sector classification as a guideline in defining high technology based firms. Therefore, from here on, new technology based firms (NTBFs) in this research shall refer to new firms which are developing new technology under OECD classification of high technology sector and product classification as discussed earlier.

- *Importance of HTSF in cluster*

Interest in the development of NTBF has grown rapidly since the 1980s (Oakey, 1991) considering the increase application of electronic technologies to production process (White and Burton, 2007). NTBF is the key result of many innovative clusters such as Silicon Valley, Route 128 and Cambridge, UK; and plays a major role in the emergence of ICT industry in America especially (Oakey et al, 1988). Based on research by Storey and Tether (1998), NTBFs show faster average growth rate of employment in Europe's high technology sectors and are expected to be an important source of future employment. However, the numbers of firms growing is not as fast as United States compared with hundreds to thousands and this may be due to the negative factors of the downsizing of large firms. NTBF also is important for the process of technology transfer (Licht and Nerlinger, 1998; Fontes and Combs, 2001) within cluster(s) and it is usually associated in generating the process of collective learning (Maskell and Kebir, 2006) through social networks. This was shown in Longhi (1999) studies where the capacity of collective learning, networks and innovative milieu contributes towards the development of high technology regions in Sophia-Antipolis, France. The performance of technology transfer role also promotes as a source of new technological knowledge (Fontes and Coombs, 2001) and enhances growth of NTBF in innovative cluster(s). Sophia-Antipolis, for example, has developed a region with high technology intensive start with the external large firms (IBM, Texas Instrument, Thomson and Aerospatiale) arrived in a vacant space and later influenced the formation of local firms in high technology industry and others to locate within the region. Longhi (1999) describe the evolution of Sophia-Antipolis' start with rapid exogenous growth since 1991 and fall in 1996. This has been taken over by the endogenous growth starting in 1996 with employment growth of +1460 in 1997 while exogenous employment growth only makes 52 jobs in the information technology industry. Today, Sophia-Antipolis is well known in Europe among its high technology activities such as in the field of computing, electronic, biotechnology and pharmacology; and also became the European host of the World Wide Web Consortioum (3WC).

Furthermore, Spilling and Steinsli (2004) studies on high technology small firms in two Norwegian technology cluster of Oslo and Trondheim found that 65% of innovation activity (mainly R&D activity) had developed new products or services and 70% had improved the products or services within the cluster. These activities have contributed towards the cluster evolution in Norway as more dynamic and this evolutionary process derives from different ways likes independent start-ups, collaboration with firms or institutions, strategic alliances, merger and acquisition, and spin-out from larger firms. Thus, NTBFs plays importance role in cluster(s) especially towards the economic growth, source of technological knowledge, process of learning and generating new ideas towards the dynamic of innovative cluster.

2.3.5 The role of university-industry-government collaborative relationship for innovative cluster

Clark (1983) was among the first to observed that advanced industrial countries have developed different forms of "co-ordination" of higher education which are located between three axes: (1) a market-like co-ordination such as that of the USA; (2) a state-induced co-ordination such as that of Sweden; and (3) a form of co-ordination which is based around what Clark termed as academic oligarchy such as those exhibited in the UK. It was this so-called triangular model of higher education coordination (Clark, 1983) that led to the introduction of the triple-helix model in order to address the many significant changes within the higher education governance model that have occurred over this period (Tuunainen, 2005).

The introduction of triple-helix model of university-industry-government by Etzkowitz and Leydersdorff (1997) mirrored that of Clark's triangle of coordination in that it focused on the relationship between university, government and the industry. They only differ in the fact that at the time Etzkowitz and Leydersdorff conceptualised this model, it coincided with a period of active academic entrepreneurship. Scott-Metcalfe (2010: 505) described that the triple-helix *"implies an evolutionary process in contrast to Clark's static triangle shape, within which the three strands form organisational bonds. Between the strands are 'trilateral networks' of cooperative interaction, which strengthen the ties between the three strands and provide multiple paths for inter-agency collaboration"*. This is an interesting notion as the current focus is on the collaborative capability of each of the actors within this network. In order to understand this better, it is therefore imperative that the discussion offers further insight into the roles played by the respective actors in creating innovative clusters i.e. university, industry and government.

- *Role of university*

There is limited literature that discusses the important role of collaboration and the actors in cluster development from developing countries perspective. Without a doubt, there is literature from developed countries perspective and in which Etzkowitz and Leydesdorff (1997) have further highlighted the important role of university in regional and innovation studies with the triple helix model. They both acknowledged the importance role of collaborative relationship between university, industry and government through entrepreneurial and knowledge seeking activities while maintaining its common traditional role. This means universities involved in regional economic development by capitalising their expertise and knowledge resources into something meaningful and lucrative. Keeble and Wilkinson (2000) explained that this new role of university involves in assisting the entrepreneurial process by providing space and facilities in its incubators to be used by its own researchers, graduates and locals.

The possible explanation on changes of the role and responsibilities of university might be related to the changes in the external environment of the cluster itself as demand for knowledge of innovation and technological change is also increasing. The best example will be Silicon Valley where a university (Stanford University) has been given further responsibilities in national priorities and government and who, in turn, gives the university autonomy and control over decision in research and development as well as inter-linkages with other institution and industry (Saxenian, 1985). The active linkages between university and their external environment evolve the role and status of the university in regional economic. However, are all of these changes possible for developing nations to respond the needs of industry, society and government and are their university's resources capable to act as strategic instrument in contributing regional development and technological changes? These challenges are crucial for the university in this nation to compete with others. Perhaps screening and analysing the role of universities and their capability provide the first step for regional policy makers to consider before formulating the necessary regional or cluster development policies or programs. The changes on university's role evidently exist in developed nation and this is probably not so much for developing nations as there are still missing components. The concept has been reviewed and more relates to developed countries and challenges to developing countries. According to Saad, Zawdie and Malairaja (2008), the main challenges for developing countries is the development of culture partnership and collaboration and also in reducing strict interaction boundaries between the organisation and institutional sphere that could hinder the 'academic entrepreneurship' phenomena.

Thus, these questions hold an interest to investigate the role play by universities in cluster development in developing countries.

- *Role of industry (firms)*

Firms manage their innovation through many ways but one of it is by learning through alliances or collaboration. This notion starts with networks linkages and interaction among others in similar or related economic activities. Porter (1990) has emphasized the important role of firms in cluster studies in his Diamond model of competitiveness of nation. He expressed the inter-linkages among buyer and supplier benefits the access of specialised information and trust building. Cooke (2007) also highlighted that trust arrived from the business networking and subsequently created social capital. This concept of innovation network appears to benefits a firm’s development internally and externally but it also offer challenges in communication and mutual understanding issues such as trust between collaborators (Tidd, Bessant and Pavitt, 2001). Other than this, the role of firms collaborating in cluster contributed towards a concentration of skilled labour and attracted others to migrate (van Winden et al, 2004) which contribute to the regional labour force. This reduces the transaction cost of hiring and better access of skilled labour particularly when collaborating with the universities.

- *Role of Government*

Government plays a major role for the innovation process of the country with the national system of innovation (NIS), where government planning to manage and stimulate its innovation process and learning at regional and national level. The concept of NIS involves the interaction between people bounded with the national culture and national government. Lundvall (1992) suggests that the ideal role performed by government and private sector should be based upon public policy where NIS could enhance technology capabilities of the nation. The public-private partnership highlighted the participation of government in regional levels of partnership programme in order to support small technology firms to evolve (Etzkowitz, 2008; Porter, 1998). However, global intervention causes challenges for NIS and possible changes to government public policy.

2.4 CONCLUSION

This chapter has discussed literature on the main concept underpinning this research which starts with the concept of innovation. The literature discussed the definition and importance of innovation for social and economic reason in the current challenge. Critics of innovation question whether it can be managed or not also presented and argued that innovation is part of management process. The concept of the innovation system was also highlighted as another fundamental concept used for the framework of the investigation and the construction of conceptual framework in the research context. The concept is deemed relevant towards the development of cluster studies and the innovation can be influenced by the elements of the system in national, regional and sectorial perspective. The innovation system concept and approaches uncovers the benefits of geographical proximity and its impact may have an influence on the way local system operates including the interaction and collaboration, networking, learning, innovation process and the regional or sectorial development.

The application of cluster concepts in innovation were also brought forward and also lays the foundations of understanding on the current research subject. Based on literature and relevant concepts, it was clear that each determinant varies on its degree of impact at different stages of cluster life-cycle. Also the role of triple helix actors: universities, government and firms (industry) in NIS, regional or sectorial innovation system have different levels of autonomy or dominancy at various stages of the cluster life-cycle (Table 2.1). However these determinants were documented well in most developed countries and poorly in developing countries. Therefore, this study is interested to investigate and explore the developmental process of cluster development in the developing countries such as Malaysia in context and the Multimedia Super Corridor (MSC) as the case study.

Determinants	**Stages or Phase of Cluster life-cycle**				
	Emergence	**Growth**	**Sustainment**	**Decline**	**Maturity**
Close relationship/collaboration with government	Very High	High	Low	High	Very High
Close relationship/collaboration with industry	Low	Moderate	Very High	High	Moderate
Close relationship/collaboration with university	Low	Moderate	High	Very High	High
Local entrepreneurs and skills	Low	High	Very High	High	Moderate
Financial support	Low	High	Low	High	High
Location	Moderate	Very High	High	Moderate	Low
Technology availability	Low	High	Very High	High	Moderate
IP	Low	Moderate	High	Very High	High
Connection to market and commercialisation	Low	High	Very High	High	Moderate
R&D	Moderate	High	Very High	High	Moderate
Government policy and regulations	High	Very High	Moderate	High	Very High
Culture and trust	Low	Moderate	High	Very High	Moderate
Economic condition and environment	Low	High	Very High	High	Moderate
Role of government	Very High	High	Low	Very High	High
Role of university	Low	Moderate	Very High	High	Moderate
Role of firms (industry)	Moderate	Very High	Moderate	Moderate	Low

Table 2.1: Impact condition of cluster's determinants in its lifecycle based on conceptual understanding (Source: author)

CHAPTER 3

THE CONCEPTUAL FRAMEWORK AND CONTEXTS

3.1 INTRODUCTION

This chapter discusses the relevant concepts and theoretical inquiry to further understand cluster formation. This is approached firstly in a review of relevance literature field of cluster formation, namely national system of innovation, triple-helix, porter's diamond model, and business networks model. Secondly, the concept from these models will be used to create a conceptual model to provide a framework for the current investigation.

3.2 MODELS OF CLUSTER DEVELOPMENT

The optimum aim of the innovation concept is for competitive reasons. Thus, with the influence of cluster's advantages, competitiveness could be achieved by continuous innovation. The innovation concept in cluster can be look at from national system of innovation (NIS); the diamond model of competitiveness advantage of nations, the triple helix model and the business networking concept. These four concepts however will be discussed further in the next section.

3.2.1 National System of Innovation (NIS)

Many authors have defined national system of innovation differently. For example, Chris Freeman (1987)

“.. the network of institutions in the public and private sectors whose activities and interaction initiate, import, modify and diffuse new technologies.”

While Lundvall (1992, p2) defined NIS as:

“.. the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge .. and are either located within or rooted inside the borders of a nation state…also national innovation system is a social system … and a dynamic system.”

Nelson and Rosenberg (1993) on the other hand defined NIS as:

“ the set of institutions whose interactions determine the innovation performance of national firms”

Patel, P. and Pavitt, K. (1994) present NIS as:

"the national institutions, their incentives structures and their competences, that determine the rate and direction of technological learning (or the volume and composition of change-generating activities) in a country".

Bryant et al. (1996) discusses NIS in a more general term, defining it as:

“… national system of innovation might be defined by listing all the factors which are relevant to business innovation.”

From the above definition, it can be gathered that there are three main elements to NIS which can help further our understanding of said system. These three elements are as follows:

First, the NIS emphasises on national *local factors* and/or identity bounded with national culture and norms of specific nation. For example the local technology, skills and knowledge, local economic setting, roles played by local institution and national policy and regulations. These national local factors are important for local development in technologies and innovation. Second, the NIS emphasises on *interaction factors* of local firms with local institution such as universities, research institutions, financial and capital institutions, government agencies and other system actors within a nation. These system actors are also for responsible in supporting and introducing innovations for the nations.

Finally, the NIS emphasises on *learning factors* of nations in different ways. This means different nations learns differently as they use different strategic approach and mechanism bounded with the different culture and norms of nations. For example the knowledge production, acquisition and transfer, technology transfer and diffusion, development of skills and capacities from developed nations are not the same with less developed nations. Thus NIS learns from others and past experiences to keep improving the local learning capability and explain and educate nations on ways to learn. These learning factors are changing on the basis of national policies and are not always perfect and policy makers learns from mistake for continuous improvement. This includes learning for all systems actors from different levels such as university, industry and government.

However, there remains issues and criticism of the NIS approach notably the argument by Godin (2009) of the insufficiency of 'formal studies' to devise measurement tools that can measure the concept and establish guidelines to empirical system mapping in less developed countries. There also the notion that NIS is constrained by a narrow focus on concepts and policy practice (Fagerberg and Srholec, 2008). Other issues with the NIS approach are: (1) it offers little by way of guidance in policy recommendations for policy makers (Lundvall, 2007); (2) it offers little operational value and is difficult to implement (OECD, 2002); (3) under developed performance indicator to gauge effectiveness of NIS in producing and exploiting knowledge.

The concept of NIS also relies heavily on the role of government as the policies author, moderator, analyst and examiner for the nation innovative development while both university and industry were both the player and influencer for the policies setting and implementations. Taking the case of Malaysia as an example, based on the discussion presented in Chapter 4, the country's NIS is mainly driven by the government.

3.2.2 Porter's Diamond Model

In Porter seminal work on The Competitive Advantage of Nations (1990) explained the strategy of competitive advantage of national economies. He argues that the strong forces of cluster lay upon four major factors of interaction as below.

i. *Firm strategy, structure & rivalry.* This forces looks at the elements relating to how the nation govern its policy and strategy on the formation of firm, development, organise, support and management; as well as the nature of domestic rivalry (Porter, 1990).

ii. *Factor conditions.* This forces looks at the elements relating to local factors production of nation such as skilled labour or necessary infrastructure which needed to compete in a given industry (Porter, 1990).

iii. *Demand conditions.* This forces looks at the elements relating to the nature of home demand for the industry‘s product or services (Porter, 1990).

iv. *Related and supporting industry.* This forces looks at the elements relating to existence or absence of nation's related industry and supplier industry that internationally competitive (Porter, 1990).

These forces or determinants accompanied by the interconnection of systems actors connect among each other and create nation's new venture and compete (Porter, 1990). However, the influence of uncontrollable factors of chance events can influence the national system as well as the government's influences, as shown in Figure 3.1. According to Porter model, the role of government can influence and be influence by each of the four major factors for building competitive cluster of region and nations through its policies. For example, the tax incentives in BoG of MSC (Appendix 1) will influence the firm strategy, structure and rivalry as it reduces burden of young firms especially in paying business tax to the government and helping them to expand their business. However, McDonald et al. (2007) found that there is not strong evidence to support Porter's view on cluster policy unless the *"deep and established clusters"* are providing the *"bedrock"* or basic elements or determinants leading to robust or good performance in cluster development. This probably gives challenges for new generation or engineered cluster to perform as the "bedrock" elements are still incomplete and/or unavailable.

Porter (1998) claimed that his "*diamond"* model promotes the clustering activities and competitive industries through linkages of *"vertical (buyer/supplier) or horizontal (common customers, technology, channel, etc.) relationship"*. Clustering in Porter's view is associated with the geographic proximity of firms with related firms, rivalry, supplier and institutions concentrated in similar, interrelated or complement product or services that promote innovative and competitiveness of the cluster itself, region or nation as explained in Chapter 2. The proximity element in cluster encourages the actors to socially interact and communicate with each other and the information flow within the boundaries share, create and disseminate valuable knowledge for development, improvement and innovation process as well as creating new entry of firms or spin-off. However, does this and all of Porter's four determinants matters for developing countries and engineered cluster of Malaysia? Neven and Droge (2001) argued that Porter's Diamond model is widely used and applied for developed countries as the example of cluster uses are based on countries such as Japan, Italy, Germany, UK and US. Adding to this, Asheim, Cooke and Martin (2006) criticised that Porter's uses secondary data of specific industries to generalise his concept of cluster and ignoring in collecting the primary data through interview to get *"empirical and analytical knowledge"* that provide in-depth meaning of inter-firm transactions for example.

Porter's model and reasoning rely heavily on various economic theories but present the discussion in logical reasoning which differs from the econometric modelling favoured by economists (Ketel, 2006). This can be one reason behind policy maker's uptake of the model in the drive to develop their countries. Furthermore, in the Porter model, understanding of the role of collaboration or cooperation is limited but more emphasis is placed on the role of linkages between firms with rivalry and suppliers in concentrated location. It is the intention of this research to add to the body of knowledge in the area of cluster formation by looking specifically at the importance of location or geographical factors. The focus of this study as has been defined in Chapter 1: the case of a Malaysian Cluster – the MSC. The geographical factors along with collaborative relationship and linkages among its actors will be examined in order to determine their contribution in the MSC cluster's development.

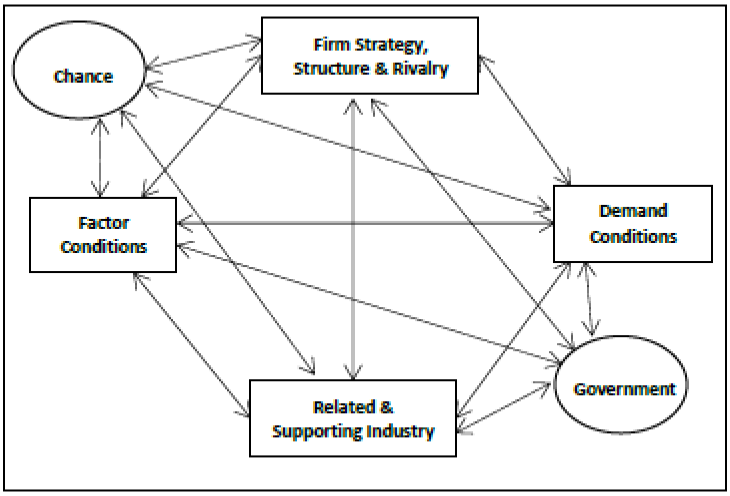


Figure 3.1: Conceptual Model of Porter's Diamond (Porter, 1990)

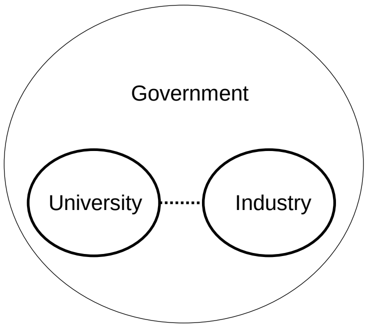
3.2.3 Triple Helix Model

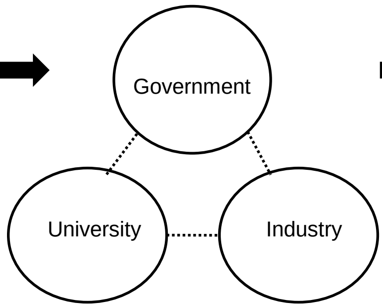
The triple helix model seeks to explore new configuration of institutional forces emerging from NIS. Its main focus is the relationship between governments, industries and universities. In their work, Etzkowitz and Leydesdorff (2000) put forth the view that the model works through a bottom-up view. The model highlighted the important role of universities as knowledge producing institution in the innovation process and the evolution or transformation role and relationship of actors i.e. university, industry and government in cluster or regional studies. Also, the emphasis here is the value of nurturing industries through the involvement of universities with researchers, government departments and agencies in ways that is best suited to the particular characteristics and creative satisfaction that embedded in firms, sector and country needs (Stiglitz, 2002). In this concept, university's role is evolving, supporting, challenging and important in innovation through capitalising its knowledge production while at the same time maintaining the traditional role of teaching.

According to Etzkowitz (2008), there are two different paths or routes to reach the triple helix which starting from (1) the important role of government in controlling the industry and university in the statist model (Figure 3.2) and then (2) in laissez-faire model (Figure 3.3) where limited interaction between actors exist as the university, industry and government are separated by the strong boundaries between them. In statist type of helix, industry and university are both involves in specialising and objectivising situation with the government in-charge of developing projects and providing resources. It also means that university is largely focusing on teaching and producing graduates for industry with far intention to get involves in research for commercialisation. Thus, the synergy between university and industry is weak and requires strong direction and leadership from the federal government. Etzkowitz (2008) explained that at this stage, the bureaucracy is major factor blocking the ideas arising from below. The laissez-faire type of helix exists as the result from the statist society motivation to change their innovation system's state and start to get close within the spheres but still concentrating working on their own. At this stage, the role of university continues to be as a teaching and learning centre but starts to provide basic research and produce graduates that are knowledgeable for the industry to use. The industry on the other hand is connecting with the university to acquire the supply of graduates with no intention to collaborate and use the basic research from university into the market. The government has less control than in statist situation but play major role when the market is not reacting well and the intermediaries are playing important role in connecting the university, industry and government in this sphere (Etzkowitz 2008).

The evolution of statist and laissez-faire society provides hybridisation of roles played by actors while maintaining their core roles, responsibilities and/or identity in triple helix model (Figure 3.4). This does not means that the university and industry are being controlled by the federal government but they have greater independence with strong interaction and linkages between actors in spheres. According to Etzkowitz (2008), at this triple helix stage, all actors contribute in innovation and economic activities within their own right and this later result in the formation of new creative organisation. The active social linkages among actors promote knowledge transfer activities and new or creative idea, product or application emerges from the combination of elements in technology and organisational innovation of the institutional spheres and technology system (Etzkowitz and Leydesdorff, 1999). The role of university in triple helix become prominent and uses its academic resources in its entrepreneurial environment to capitalise its knowledge through many forms such as patenting, licensing and consulting. At this stage, the model is claimed dynamic towards the innovation process and work at its full capacity. According to Saad and Zawdie (2005), the role of actors is the fundamental element in triple helix model as it involving the complex *"interactions within and between the principal players"* in sphere. The role of actors evolve in this stage along with the smooth circulation of knowledge and strong interaction occur at micro and macro level (Etzkowitz, 2008), while knowledge become important as part of resources in sectorial, regional or national level. This enables healthy linkages and interaction that lead towards greater trust among actors in spheres.

However, it's very difficult for developing countries to reach the ideal triple helix environment but useful to employ the model for innovation and technological progress of their nation (Saad and Zawdie, 2005; Almeida, 2008). This research hopes to use the concept of triple helix in examining the role of actors and its relationship in sphere or cluster through the collaboration activities.





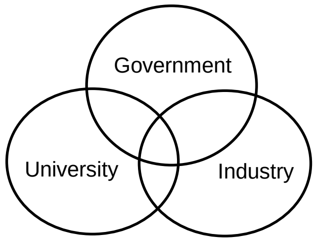


Figure 3.2: The Statist Model Figure 3.3: The Laissez-faire Model Figure 3.4: The Hybrid of Triple Helix

(Source: Etzkowitz, 2008)

3.2.4 Business Networks, Social Interaction and Relationship

Business networks describe by Gomez Arias (1995) as *"a cluster of firms or specialist unit co-ordinated by market mechanisms instead of chains of commands"*. He also suggests that networks can be conceived as an intermediate or hybrid form of organisation in the middle of the road between markets and firms. Swan et al (1999) suggests that "business networking is a social communication process, which encourage the sharing of knowledge among communities". Hendry et al (1995) describes networks as *"a means by which firms gain knowledge of their customer markets and access to various materials, financial and human resources for doing business"*. These three definitions describe business networks as a process of communicating between one organisation and another by sharing information and/or knowledge that could benefits the community or organisation. This knowledge intensive network became more important for innovation and in the interest of policy makers. As describes by OECD (2008, p. 7) *"the potential for innovation depends on how well knowledge circulates and how well the system is connected: policies to foster or enable the development of world class clusters and networks are thus of growing importance"*. Hence, the effectiveness of knowledge circulation and connection in the system is clearly not solely the policy maker's responsibilities but also requires the strategic approach in interaction and relationship within the systems actors in spheres.

According to Holmlund and Tornros (1997), there are three layers of network in business networks: (1) a production network layer; (2) a resource network layer, and (3) a social network layer; which relates to different type of system actors as shown in Figure 3.5. The first layer indicates firm actors who are referred to as actors within firms or individuals in a firm itself executing the production activities or tasks in business network (e.g. scientist, researcher, production individual either involves in the production of product, services and/or system of firms). The connection made by firm actors in business network with other engaging in the same production activities constitutes production network layer. Thus more actors involved and interconnected. However, firm actors need resources (e.g. financial resources, technological capability, knowledge in commercialisation and connection to markets) which they do not have to carrying out the production activities. This make up the second layer where resource actors (e.g. financial institution, venture capitalist, government agencies and research institution) provides support to firm actors and together they form resource network layer in the business network. At this stage there are more actors involves compare to previous layer and the interaction also getting more complex. The third and final layer refers to interconnected human actors consisting of firms actors, resources actors, individual and group of people in different firms who have the knowledge and important to their firms involves in the business network. All of these interconnection and relationship embedded within the spheres for example in national, regional, local or sectorial levels became more complex. The three networks layers model suggested by Holmlund and Tornros (1997) have three dimensions which are structural economic and social relating to networks layers as shown in Table 3.1. The relationship matrix concentrates on the moves of different perspectives of relationship between networks layers in business setting.

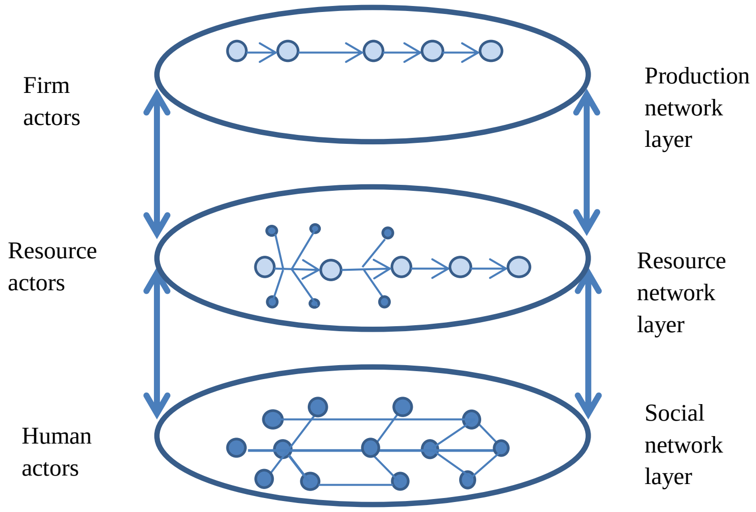


Figure 3.5: Three network layers in a business network (Source: Holmlund and Tornros; 1997)

Network Layer	Dimension		
	Structural	Economic	Social
Production network layer	Links Connections	Investments Bonds	Connections Bonds
Resource network layer	Ties Connections	Investments	Connections Bonds
Social network layer	Links Connections	Investments	Atmosphere Bonds Trust Commitment

Table 3.1: A relationship matrix of relationship concepts on the three network layers (Source: Holmlund and Tornros; 1997)

Previous research on business networks suggest that having interaction and relationship with other firms or institution; and sharing knowledge could have a vital impact to an organisation. For example Dennis (2000) indicated that a business network is a marketing advantage to the organisation. OECD (2008) and Gomez (1995) suggest it is a key driver to foster the process of technological innovation and competitiveness (Porter, 1990) particularly for companies with technological focus. In addition to these benefits, Bengtsson and Kock (1999) suggest that firms can develop and expand its business through interaction with others. Dennis (2000) also suggests that firms could achieve economies of scale through networking as this allows companies to take advantage of lower initial investment cost and lessen the capital expenditure in the future. However, the trust element in business networks is an important ingredient to makes the social interaction success (Holmlund and Tornros, 1997; Swan et al, 1999). This is because the knowledge that is shared between firms can sometimes turn out to be false or inaccurate; thus will endanger the mutual relationship between firms and communities in cluster. Therefore, knowledge networking with universities and other research institutions would be another route to acquire the trustworthiness of knowledge for firms to excel and improve their learning as to innovation and technological development.

3.2.5 Collaborative Innovation

Innovation is increasingly associated as a source of technological development through a cumulative combination of different knowledge, skills and expertise that exist within different organisation. The inter-organisational relationship may be interactive and complementary and it has effects on technological innovation. This has influence on various forms of inter-organisational collaborative ventures for innovation (Freeman, 1991; Hagedoorn, 1995, Faems et al., 2005). Collaborative innovation strategy of firm can either be a short-term or long-term objective. Regardless as to what sort of time frame the collaboration is for, what matters is the number of collaboration involves as according to Fames, Van Looy, and Debackere (2005) research findings concluded that *"the more firms engage in a variety of different inter-organisational collaborations, the more likely they are to create new or improved products that are commercially successful".* The concept of inter-organisational collaboration is not new but widely used in most innovation model such as in cluster, triple helix and NIS.

Miles et al (2000) suggest that knowledge creation and utilisation can lead to innovation interlinked by the role of collaboration capability illustrated in a model in Figure 4.6. The model explains on how collaboration as an originator for knowledge creation and transfer with time, trust and shared mental territory seen as prerequisites of collaboration. Miles et al. (2000) point out the need for a broad entrepreneurial empowerment for the innovation process and commercialisation application. The model also stresses the role of collaboration capability and the quality of collaborative relationships with internal and external stakeholders (Miles et al., 2000).

Inter-organisational cooperation or collaboration is also best known as strategic alliance, the objective of which is to share or transfer knowledge including skills and resources for gaining and mutually benefit from the action. Many authors (McCutchen Jr. and Swamidass, 2004; Roijakkers and Hagedoorn, 2005) believe that strategic alliance allows firms to develop synergistic relationship through technological complementary among partners that can drive the organisation's competitiveness. This research hopes to use the general concept of collaboration for innovation as an instrument to measure the collaborative relationship among actors in cluster development.

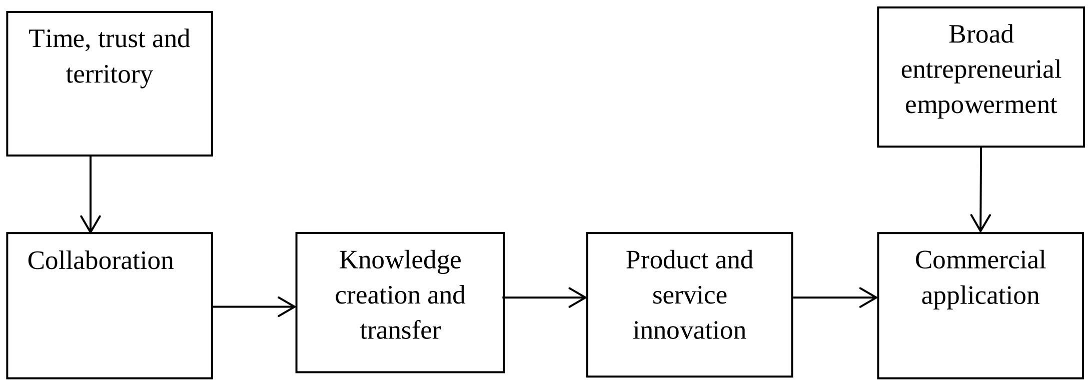


Figure 3.6: Role of collaboration in innovation process (Miles et al. 2000)

3.3 BUILDING CONCEPTUAL MODEL IN CONTEXT

Based on the related literature research (Chapter 2) and understanding of related innovation concept in cluster discussed in this chapter, the conceptual model for this research was designed and proposed. Considerations were taken from the perspective of research phenomenon and context of this research along with the research question addressed.

3.3.1 The Research Phenomenon

The purpose of this study is illustrated in Figure 3.7 and Figure 3.8 with the studied phenomenon in the middle of the triangle. Figure 3.7 shows the general research phenomenon which indicates three important elements in doing business research which are context of the study, chosen concept and theory for the construction of models and frameworks of the study. Figure 3.8 shows the specific research phenomenon including the three important elements of this research as undertaken. The specific interest in this study is to look at the context of cluster development. Collaborative relationship among system actors is one of the main critical success factors identified within global literature search for cluster development apart from innovative technology, human skills, location, presence of large firms and access of finance (DTI, 2004). The important element of interaction and linkages with actors in cluster is also mentioned in the innovation concept which was described in Section 3.2. The cluster model will be used as the theoretical references for this research investigation along with the concept of collaborative relationship of triple helix actors (i.e. universities, industry and government). It is interesting to investigate this phenomenon specifically for developing countries like Malaysia.

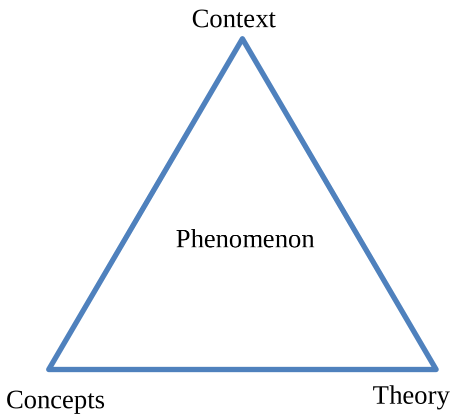


Figure 3.7: General research phenomenon

(Source: author)

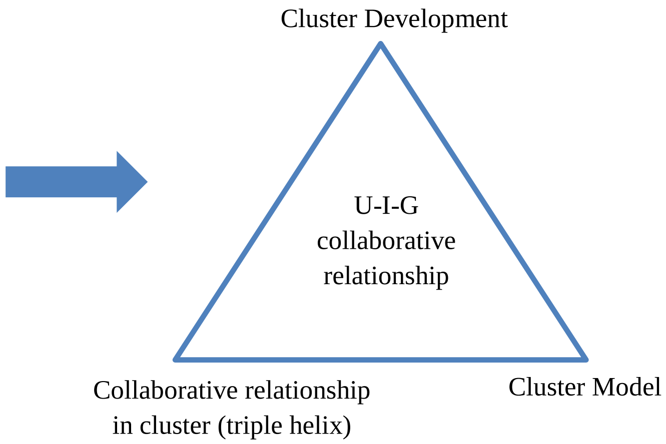


Figure 3.8: Specific research phenomenon: University-Industry-Government (UIG) collaborative relationship

3.3.2 Critical Determinants for Cluster Development

DTI (2004) outline the 'softer' and' harder' factors underpinning the successful cluster identified within global literature search. The 'softer' elements include the networking partnership and institution development, while the 'harder' aspect includes physical infrastructure and presence of large firm within the cluster. Other factors include entrepreneurial culture, presence of leadership, access to finance and markets, and business support services. Earlier in Chapter 2, this research has also identified and discussed the determinants involved for cluster development based on literature research. All of these determinants can be identified as micro and macro factors of cluster development as illustrated in Figure 3.9 that are interconnected and needed with each other in order to achieve an innovative cluster.

Smit (2010) conclude that Porter's (1990) Diamond Framework and his work on clusters and competition (Porter 1998, 2000, 2004) is not about trade, patterns of trade, gains from trade, but is rather a general framework for analysing country-specific sources of advantage that enhance the international competitive advantage of firms. Further to the earlier point above, Smit (2010) further iterate that Porter's (1990)

Diamond Framework provides the link between firm and country-specific sources of competitive advantage that firms leverage to gain international competitive advantage.

There are four macro factors identified which were (1) policy and regulations that set by the federal government, (2) economic conditions of the cluster and the nation itself, (3) the availability and access of technology and (4) the local culture of the cluster including the behaviour and pattern of trust elements of the society involved in cluster. The factor of economic conditions is the most crucial to control. However the other three identified macro factors and micro factors provides support and enabling tools to structure the condition and state of the economic in regional or national level. There were seven micro factors identified. They were (1) collaboration capability of the actors in cluster including motives and barriers involved, (2) the provision of local skills, (3) the IP and patent for security and protection of the knowledge created i.e. design, formulas, ideas and prototype (4) the support and access of financing, (5) the market connection and commercialisation issue (6) the allocation, commitment and practical contribution of R&D activities and (7) the location uniqueness or advantage including sound infrastructure and conducive business and research operation environment.

It is understand from the literature research and related innovation concept in cluster studies that the combination of both macro and micro factors of cluster determinants provides essential elements to stimulus the formation of new and/or creative firm or spin-off in the innovative technology cluster. Without a doubt the healthy business and social interaction between actors in cluster does matter at the current technological pace for creating a competitive advantage of region or nation. The social networking activities, whether formal or informal, can spur the trust building among actors and enhance the density of relationship and trust. This probably gives easier introduction for any future collaborative work. Collaboration can be a useful instrument to accelerate the innovation and technological progress, so that be able to catch-up with the leading cluster such as Silicon Valley, Boston, Cambridge, Helsinki and Sophia-Antropolis. Through collaboration, knowledge creation and transfer are possible. The role of actors in cluster is important to perform the collaborative activities and relationship. However, the collaboration capabilities are dependent on how the actors operate and conduct the projects including the barriers and challenges occur; and the characteristic or nature of the projects including the motives and objectives of the collaborative projects and relationship. This was illustrated in Figure 3.10.

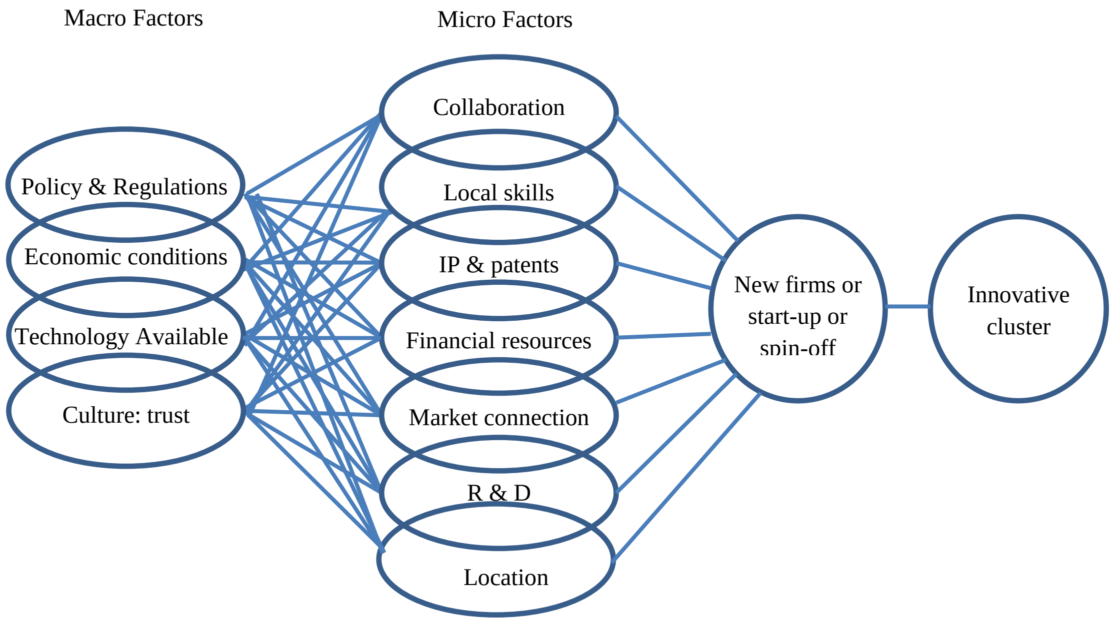


Figure 3.9: Micro and macro factors of cluster development (Source: author)

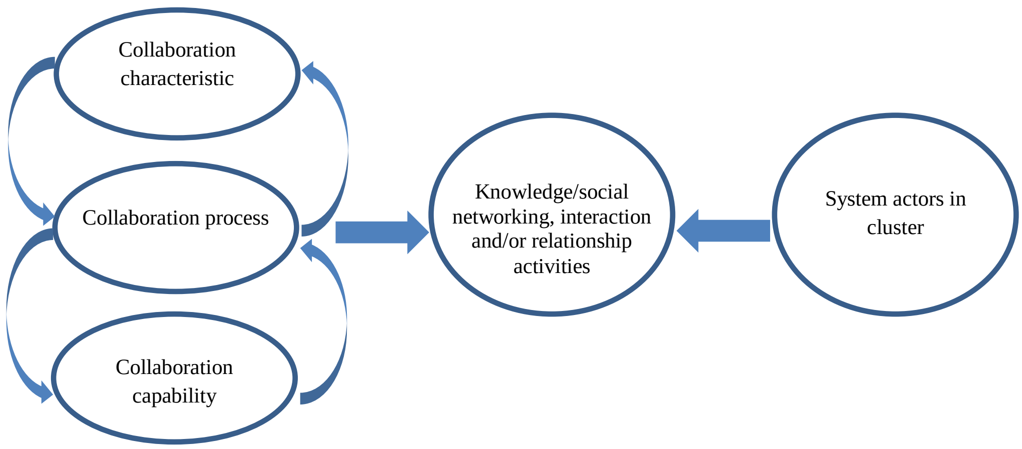


Figure 3.10: Collaboration, actors and relationship in cluster (Source: author)

As mentioned in Chapter 2, clustering provides economic and social benefits for innovation and technological transformation at regional or national level. The role of actors including universities, technology firms and government, and their relationship with each other was found to be significant in the development of cluster. In the context of developing country such as Malaysia (Chapter 4), the cluster concept was used to project the country determination of economic transformation and vision to upgrade their status to become a developed nation. Related innovation concept in cluster was discussed in this chapter, Chapter 3. The conceptual model for this research was then designed and proposed (Figure 3.11) to be used and guide this research on its mission to address the research questions.

The model highlighted the important role of actors and its relationship as an engine to cluster development and success, while collaboration as a strategic instrument for knowledge and technology creation, dissemination, assimilation and transformation. These two factors are among micro and macro crucial determinants for technology cluster. This model will be used to access the investigation in the context of this research, MSC as an engineered cluster in developing countries.

3.4 CONCLUSION

Recognizing the benefits of clusters as a form of economic organisation has influenced governments to implement policies (Sölvell et al, 2003), intended to launch initiatives to support existing clusters or to form new ones. Most of the initiatives launched tended to be within the following context: (1) Small and Medium Enterprises (SMEs); (2) regional industrial development; (3) attracting external funds and foreign investors; and (4) research and innovation at a national or local level. It must be stressed here that economic development modelled around the cluster concept has been replicated by many countries and can help develop industry competitiveness. However, in order to achieve this, the role of actors within technology clusters need to be revisited. The relationship and interaction of actors need to be made more explicit in supporting the determinants identified here. Although existing cluster analysis highlighted their advantages, the interconnection of factors and their effect on the cluster, the economic theory has not yet provided a model that allows both the analysis and the definition of a process for implementing a successful cluster.

In conclusion, this chapter has discussed the innovation concepts in innovation system and cluster that are related to building the conceptual framework and model in the context of this research. This includes the NIS, Porter's Competitive Advantage of "Diamond" model, triple helix, networking and relationship; and collaboration innovation. The weakness of existing models such as NIS (i.e. lack of empirical system mapping, heavily focused on role of government and difficult to implement); Diamond model (i.e. lack of primary data for in-depth understanding of the forces and; failure to address how to develop or engineer cluster and analyse the path of cluster development); and triple helix (i.e. less detail and difficult to explain of role of actors in transition between each three stages) were identified. These gaps provided an opportunity to reinforce, supplement and expand the models with the introduction of conceptual model developed for this research.

The second section of this chapter presents the conceptual model (Figure 3.11) that was designed and proposed to conduct the investigation of this research. Apart from the related theories and concepts discussed, detailed consideration was taken from the perspective of research phenomenon, context of research and research question for the construction of the conceptual model. The elements of micro and macro factors of cluster development were incorporated in the model and addressed the importance of the role of collaboration and the role of actors (universities, firms/industries and government agencies). It was highlighted that the intention is to test the conceptual model in context by using the matrix analysis (Table 2.1) that was developed based on conceptual understanding and the stages of cluster's life-cycle. Following this, the conceptual model will be used and made as guidelines for the method to be used and analysed for this research, the empirical findings, critical discussion and most importantly to answer the research question and objectives. This framework would also hope to contribute in filling the gaps in the current models (NIS, Diamond model and triple helix), practical contribution in case context (Malaysia), developing countries and other nations that are interested in cluster development framework and analysis; and in innovation and cluster related literature.

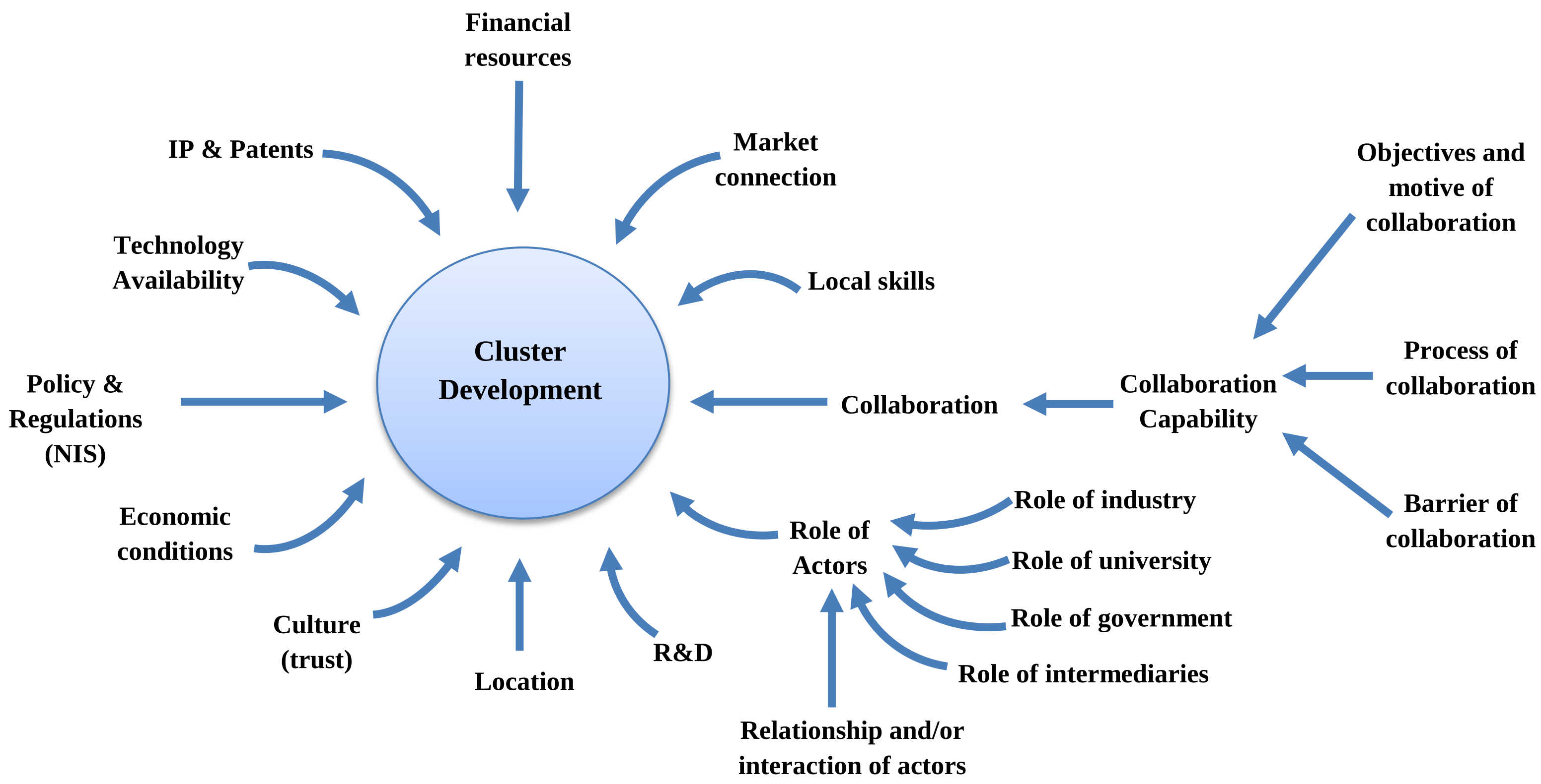


Figure 3.11: Role of actors and collaboration in technology cluster development – a conceptual model in context (Source: author)

CHAPTER 4

MALAYSIA AS A CONTEXT OF STUDY

4.1 INTRODUCTION

This chapter focuses on a Malaysian case study (MSC). The discussion takes on the following themes: (1) a brief historical account of Malaysia's economic development from the moment it gained its independence from Britain to the present day; (2) an account of Malaysia's National System of Innovation (NIS); and finally (3) an overview of cluster development in Malaysia through the many initiatives to transform the country into a developed nation.

4.2 MALAYSIA: AN OVERVIEW

Malaysia has a rich history and for centuries served as an important trade stops for spice and silk traders plying the route between the Orient and Europe. Malaysia in its present form is a young country, having been only formed on 31 August 1963 after gaining its independence from Britain on the 31 August 1957. Its capital city is Kuala Lumpur while Putrajaya is the new government administrative city developed to take the transportation and real estate constrain off Kuala Lumpur. It has been in use by the federal government since 1999. However, Kuala Lumpur remains as Malaysia's capital city and centre for commerce and finance. The country consists of 13 states and 3 Federal Territories, with total area of 330,252 per square kilometres. Separated by the South China Sea, the country has two regions which are Peninsular Malaysia and Malaysian Borneo also known as East Malaysia (Sabah and Sarawak).

4.2.1 Population and Labour Force

Based on information from the Malaysian Department of Statistic (July 2009), the population of the country is just over 28.3 million and has had 2.3% average growth in population recorded between 1991 and 2009. The population consists of four major ethnic groups which are Malay (also known as Bumiputra), Chinese, Indian, other Bumiputra (made up of various diverse groups of indigenous people from the Peninsular, Sabah and Sarawak) and other ethnic groups. Malay is the majority ethnic composition of the population making up 66.6%; followed by Chinese with 24.8%; Indian 7.5%; other Bumiputra 11.8% and other ethnic groups with 1.1%. Out of this total population, 9.5% are non-Malaysian citizens who live in the country. This diverse composition makes Malaysia a multicultural nation with varying races and religions. Malay language is the mother tongue of the nation but English is the second language and is commonly used in business and commercial activities.

Year	Total labour force ('000)	Unemployment rate by %	No formal Education ('000)	Primary Education ('000)	Secondary Education ('000)	Tertiary Education ('000)
2002	9886.2	3.5	523.2	2326.0	5383.9	1651.4
2003	10239.6	3.6	488.2	2290.4	5665.0	1794.5
2004	10346.2	3.5	483.2	2248.6	5699.4	1908.7
2005	10413.4	3.5	476.3	2144.8	5795.2	1995.0
2006	10628.9	3.3	403.7	2172.7	5989.4	2061.9
2007	10889.5	3.2	432.6	2104.0	6133.9	2210.0
2008	11028.1	3.3	489.0	2016.7	6186.4	2336.0
2009	11315.3	3.7	438.9	1970.5	6262.0	2643.8
2010	12303.9	3.3	452.7	2168.2	6792.0	2891.0
2011	12675.8	3.1	401.8	2137.5	70298.8	3106.8
2012	13119.6	3.0	401.4	2198.7	7321.9	3197.6

Table 4.1: Labour force by educational attainment and unemployment rate for Malaysia from 2002-2012 (Source: Department of Statistics, Malaysia; October 2013)

For the labour force, the number has increased to nearly 0.8 million from 2010 to contribute in the Malaysian economy, and the unemployment rate reduced by 0.3%. However, the statistics (Table 4.1) from the Department of Statistics indicates that the education level of the labour force is dominated by primary rather than tertiary level i.e. higher education. This means that the labour market is lacking high levels of education which probably explains the limited availability of local skills.

4.2.2 Natural Resources (Basic Factor Conditions)

Malaysia is rich in natural resources and is well-known in areas such as agriculture, minerals and forestry. Natural rubber and palm oil are the main export products of the country, followed by saw logs and timber, cocoa, pineapple, pepper and tobacco. According to the Malaysian Department of Statistic (December 2009), palm oil and palm oil-based products contributes 8.3% of total export of the country and is ranked as the second largest revenue earner of the country. However, forestry remains one of Malaysia's key natural resources even though its contribution has decreased to 0.8% (mainly timber and timber products) annually due to the government commitment to protect the environment and ecological system of the country. The natural resources of the country are nowadays managed in a sustainable manner. The government currently encourages the cultivation of only high-value trees and re-planting of fast-growing timber species to increase forest resources.

Regarding mineral resources, petroleum and liquefied natural gas remains the major contributor to the Malaysia economy followed closely by tin and other minerals such as copper, iron-ore, coal, clay, limestone and phosphates. The country used to be one of the major tin exporters in the early 19th and 20th centuries until the collapsed of the tin market in the 1970s. Its position as the key contributor of the economy was then replaced by natural gas and petroleum. Petroleum and natural gas was discovered in oilfield offshore of the Peninsular notably off the shore of the state of Terengganu and both East Malaysia states of Sabah and Sarawak. These two minerals resources have contributed significantly to the Malaysian economy and its growth so much so that the national oil company, PETRONAS is currently ranked 75th place in the latest round of Fortune Global 500 lists, with revenue of $94.3 billion and net profit of $16 billion (Fortune Magazine, 2013).

4.3 THE MALAYSIAN GOVERNMENT

The role of government is recognised as vitally important for developing countries such as Malaysia. This section discussed the political party that has governed the Malaysia for the past 45 years and its role in transforming the Malaysian economy from agriculture to manufacturing based.

4.3.1 The Government and Political Environment

Malaysia has inherited many characteristic from the British colonial system especially in its public service management and practices. Malaysia's political system is based on the constitution monarchy modelled after the Westminster parliamentary system in the United Kingdom. The government is headed by the Yang Di-Pertuan Agong also known as the King of Malaysia or Paramount Ruler under the constitution and receive the advice of the Prime Minister and cabinet ministers. Interestingly, the Yang Di-Pertuan Agong is elected by nine other hereditary kings or rulers every five years.

Malaysia practices a democratic parliamentary system. The bicameral parliament consists of the Senate and House of Representative. All 222 members of the House of Representative are elected by each constituency in a general election which is held every five years. Meanwhile, the Senators are divided into two categories where 26 members are elected by the State Legislative Assembly to represent 13 states and 44 members appointed by the Paramount Ruler on the advice of the Prime Minister. The Senators sit for three years term but only for a maximum of two terms.

Malaysia has been ruled and governed by a coalition government known as National Front (formerly known as the Alliance) since gaining its independence from the British in 1957. The coalition was formed in April 1955 before the first federal election on 31st July 1955. The National Front consist of three large race-based parties: (1) the United Malays National Organization (UMNO) party; (2) the Malaysian Chinese Association (MCA); and (3) the Malaysian Indian Congress (MIC). Due to the success of this coalition, the National Front (NF) has boarded-up its representations and at present consists of sixteen other parties including political parties from Sabah and Sarawak. The leader of the majority party who won the general election will be the leader for the NF, and currently UMNO has the majority seat in the parliament and its president, Najib Tun Razak is leading the country as the Prime Minister.

The 12th Malaysian general election in 2008 was the worst result for NF in the coalition's history. The opposition parties, primarily represented by Democratic Action Party (DAP), the Pan-Malaysian Islamic Party (PAS) and Parti Keadilan Rakyat (PKR) won 82 seats of the parliament seats and NF only secure 140 seats (out of 222 seats of parliamentary). The primary issue relating to the NF's major losses in the 12th general election is due to few parties having a no-confidence vote against the 5th Prime Minister, Tun Abdullah Ahmad Badawi's leadership at the time. The critics argued his lack of strong leadership in the federal government and his handling of economic issues especially Sabah's oil revenue as well as the threat of growing illegal immigration from the Philippine. Among other issues raised are inflation, fuel subsidies, shortage of goods (i.e. sugar), mismanagement, corruption and the allegation of unfair election. The loss of confidence also can be attributed to his son-in law who was alleged to be influencing his decision making for the country. This political turmoil put Abdullah in a difficult position and on April 3, 2009 he handed over his position as Prime Minister to Najib Tun Razak (who was the Deputy Prime Minister).

Under the leadership of Najib Tun Razak, he launched the concept of "1Malaysia" on 16 September 2010 to emphasize the national unity across his management for social and economic prosperity in Malaysia multi race and religions. The opposition leader, Anwar Ibrahim condemned the concept as being a political strategy for NF to secure votes in preparation for the 13th General Election (on 5 May 2013). Despite accusation from the opposition parties, the NF won the latest general election with a simple majority. This result was the lowest win of the coalition party since 1955 with a majority of 139 (62%) of 222 parliamentary seat.

The most challenging issue for the NF government is to strengthen the racial integration and unity especially among its coalition, but its critics have argued that the government is overshadowed by the UMNO. The critics also argued that most government projects or contract are given to those who are allied with the rich and influential Malay politicians. The allegation of corruption among politician and government's officials is an on-going issue. The government leaders have also been accused of abusing the New Economic Policy (NEP[1]) from the members of public and also from the opposition parties. However, according to the Malaysian Anti-Corruption Agency (MACA) there is no record of a politician being accused of corruption, but in year 2007, there are 133 or 60% (out of 221) of public officials accused of corruption in court, but none were found guilty. From an international point of view, Malaysia was ranked at 54th out of 176 countries surveyed with Corruption Perception Index (CPI) score of 49/100 in

[1] The NEP was launched in 1971 to eradicate the poverty and economic differences between Malays or Bumiputra and non-Malays or non-Bumiputra.

Global Corruption Barometer 2013 by Transparency International for issues on corruption of countries in public sectors. The rank has improved by 2 points as compared to the year before but still far from its neighbouring country Singapore (rank 5th, CPI = 87/100). It was not political parties that were highlighted in the corruption's perception report for Malaysia, but the police institutions that give members of the public cause for concern.

4.3.2 The Government and the Malaysian Economy

In 2012, Malaysian Gross Domestic Product (GDP) was 5.6%, which is a reduction of 2.2% since 2010. Malaysia is among the world's major producer in computer disk, electric and electronic, agriculture and palm oil industries. The country also produced its own state-controlled car called Proton and is competing with Thailand, Indonesia and other South East Asian countries in tourism industry. Malaysia's economic progress and development was considered one of the best since gaining its independence from the British in 1957. The following briefly discuss the significant economic development that the country has gone through based on an economic history report by the Malaysian Economic Planning Unit (EPU):

After independence (1957-1970), the natural resources of rubber and tin were two main exports that contributed 70% to export earnings. The import substitution approach has been used to promote the industrial development and Malaysia emerged as a strong economic base in late 1960s. The diversification of agriculture industry i.e. timber and palm emerged as another important commodities because of the drop of export tin and rubber from 70% to 30% in 1070s. During this period, the overall economic growth was at 6% and this was thanks to the discovery of oil and gas in Sarawak.

A period of high growth (1971-1983) occurred when the government introduced the First Outline Perspective Plan (OPP1) which outlined broad socio-economic framework covering the year 1971-1990. Under this OPP1, the NEP was introduced to eradicate poverty and restructure society. Among programmes to eradicate poverty were provision to improve input and facilities in economic and social services such as education and to support Malay and other indigenous people involve in all aspect of economic activities of the nation. The economic growth slowed in 1980s due to world economic recession of oil in 1979. The country experienced deficit position in budget and balance of payments.

The economic restructuring period (1984-1990) was the main priority of the government to recover from the world's oil crisis. The public sector expenditure was controlled to reduce the deficit budget and the government introduced privatisation of public sector agencies. This has influenced the economy recovery in 1987 with high growth of 9.3% until 1990 and this has transformed Malaysia into private sector driven economy approach. The national car, Proton, was in first production and has contributed in manufacturing industry that enables Malaysia to reduce its major import of capital and intermediate goods for its growth.

The prosperity and adversity period (1991-2000) was the start of the Second OPP (OPP2) that covered the economic plan for the period of 1991 – 2000. The Vision 2020[2] (or Wawasan 2020 in Malays) was launched along with the National Development Policy (NDP) based on the NEP including programmes to solve poverty, improve private sector's contribution and job creation. The economy grows with GDP stretches at 8.5% per capita income between 1991 and 1997 due to the favourable condition of

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[2] Vision 2020 was launched in 1991 and introduced by Mahathir Mohamad (4th Prime Minister) in 6th Malaysia Plan to transform Malaysia into industrialised country with high income and develop nation by year 2020 (can be access online at http://www.wawasan2020.com/vision/index.html).

macroeconomic environment that has attracted large capital flows. The Multimedia Super Corridor (MSC) was launched in 1996 as a new regional economic project to transform the economy and technological development of Malaysia by focusing the ICT industry in realising the Vision 2020. The Asian financial crisis of 1997 has resulted in a deep recession, affecting employment, poverty and bankruptcies. The National Economic Action Council (NEAC) was established in January 1998 to assist government in recommending solutions to rejuvenate the economy. The NEAC introduced National Economic Recovery Plan (NERP) with aims including to stabilising the national currency and financial market. The Malaysian central bank had decided to peg the national currency, which is Malaysia Ringgit (RM) at 3.80 to 1USD in order to maintain the exchange rate. This decision has affected the Malaysian policymaker that they have less control over this, so that Malaysia can continue to participate in an increasingly tension of global economy (Charette, 2006). Danaharta was established in September 1998 to manage national asset after the financial industry facing problems of many non-performing loans from the 1997crisis. However the economy grow back to7.2% in between 1999 to 2000 even though facing difficulty grow in 1998. This has shown that the role of government in its economic and financial strategies was crucial to the Malaysian economy.

Resilient and competitive period (2001-2010) was the beginning of the launch the National Vision Policy (NVP) to incorporate Vision 2020, NEP and NDP. The OPP3 was launched to mark the next 10 years policy, which was formulated based on NVP to focus on building Malaysia as resilient and competitive nation. This included strategies that can promote and develop knowledge-based society along with rapid local growth driven and targeting 30% of Bumiputra participation in endogenously driven growth by year 2010. Throughout this decade, Malaysian economy was competitive but had slow growth at 5.8% due to many international crises such as the world influenza virus attack and war on Iraq in 2003. During the Euro financial crisis in 2010, the Malaysian economic was not much affected as the government has prepared in advanced with the launched of the First Economic Stimulus Package in November 2008 and Second Economic Stimulus Package in 2009. The government has injected approximately US$2.2 billion and US$18.8 billion in both stimulus packages respectively to fund local economic projects to improve the effect of exports problems in early 2008. Thus, in 2010, the Malaysian growth had increased by 7.2% but was down to 5.1% in 2011 due to the US economic crisis of its debt deficit and high unemployment rate.

4.3.3 Transforming Malaysia into High Technology Nation

In 2010, the Malaysian government announced the new economy policies and strategies of the country, New Economic Model (NEM). The new policy is aiming to transform the country into a high income nation with US$15000-20000 per capita by 2020 along with competitive and sustainable economies. There are four pillars or support policies underlining the NEM. They are (1) the 1Malaysia policy concept that emphasise the unity and prosperity, (2) Government Transformation Programme (GTP) that focuses on transformation of government in delivering its services and its accountability to members of public and businesses; and increasing national income; (3) Economic Transformation programme (ETP) that focuses on the development of selected key growth areas or National Key Economic Areas (NKEAs) and to promote private sector-led growth; and (4) Ten Malaysia Plan that outline plans and strategies of the economic transformation for period of five years (2011-2015). These four pillars of policy were set in line with the desired characteristic of developed nation in 2020 which were market led economy, well governed type of nation, economy are regionally integrated and dynamic, entrepreneurial and innovative economic environment with skilled labour and to have capable indigenous technology.

Time-frame planning	Type of Planning	Policy of planning	Objectives of planning
Long Term Planning	Vision 2020, 1991-2020	. Incorporates of all policies: NEM, NVP, NDP and NEP	Develop nation
	New Economic Model (NEM), 2010 -2020	. Incorporates policies of 1Malaysia (2009), GTP (2010), ETP (2010), 10th Malaysia Plan and continuation from NVP	high technology income, communities wealth inclusiveness, economic sustainability
	Third Outline Perspective Plan (OPP3), 2001 – 2010	. National Vision Policy (NVP): combination of Vision 2020, NEP, NDP, 9th and 8th Malaysia Plan	Knowledge based economy and society,
	Second Outline Perspective Plan (OPP2), 1991 – 2000	. National Development Policy (NDP) . National Economic Recovery Plan (NERP) . 6th and 7th Malaysia Plan	Job creation, poverty, education, target for 30% Bumiputra involvement in business
	First Outline Perspective Plan (OPP1), 1971 – 1990	. New Economic Plan (NEP) . 1st to 5th Malaysia Plan	Eradicate poverty, infrastructure and education
Medium Term Planning	Five years development plan	. 10th Malaysia Plan (2011-2015) . 9th Malaysia Plan (2006-2010)	
	Mid-term review of the five year plan	. Mid-term review of 9th Malaysia Plan (2006-2010)	
Short Term Planning	Annual Budget	. Yearly budget based on the five years plan	

Table 4.2: Malaysian economic planning horizon and policies

(Source: author – based on Malaysian government policies and planning)

All of these policies and the previous implemented policies document the commitment of the government in attempting to become a developed nation by the year 2020 by incorporating knowledge economy in its strategy as well as the regional cluster. . The ability of government to change and alter the policies has shown that the Malaysian government has responded to Porter' Diamond model at both regional and national level (Porter, 1998). It can be seen from Table 4.2 that the Malaysian government has effectively laid out a planning horizon in order to achieve the objective of being a developed nation. This planning horizon summarise the role of government in planning the appropriate strategies and policies that are achievable along with the determination in realising the national Vision 2020. It can be considered as part of the country's NIS in that it lays the foundation for strategy and financial budgeting. Dunphy and Herbig (1994) discussed the importance of culture in developing institutional relationship within an NIS. Thus there is a need to identify their relationship particularly the role and relationship that exists between industry, government and universities.

4.4 UNIVERSITIES IN MALAYSIA

Mohan et al (2004) work identified education system as a key part of Malaysia NIS to provide broad, thorough and high quality level of education. This outlines the important role of universities in education system and NIS. However, figures obtained from various issues of the Malaysian Five Year Plan suggest a worrying trend of shortages in science and technology (S&T) human resources from 1970 to 2000 (Lai and Yap, 2004). To a certain degree this suggests that the education system in particular the universities are not producing enough science and technology graduate to meet the demands from industry even though the numbers of locally trained graduates have increased over the years. In recent report of Tenth Malaysia Plan for 2011-2015, the numbers of degree holders are increasing including the PhD holders since 2006 (Table 4.3). Improvements in the numbers of graduates in S&T from local institutions can be attributed to the government's policy of investing in education. Mani (2002) argued that the Malaysian government's commitment in human capital development through public education expenditure is comparable to other NIEs and developed countries such as

Japan and the United States. Lai and Yap (2004) argued that there is no strategy that can guarantee the success of technological progress in Malaysia.

To this extent the investment in education even though comparable to others is still ineffective and improvement in this area should remain the priority of the Malaysian government. The introduction of the Smart School system as one of the MSC flagship application seems to suggest that steps are being taken to address this at the primary and secondary education level. The purpose behind this introduction is to prepare Malaysians for the challenges of the knowledge based economies. With regards to tertiary education, it can be seen that there has been a remarkable growth in terms of the graduates number from the institutions of higher learning in Malaysia from 170 000 in 1996 to 623 000 in 2000 (Lai and Yap, 2004).

Level of Study	Number of Students				Estimate	Target	
	2006	**2007**	**2008**	**2009**	**2010**	**2012**	**2015**
Certificate	112 922	124 225	111 125	122 260	126 089	136 900	161 749
Diploma	240 189	271 918	296 296	350 873	375 699	431 360	532 502
First Degree	348 369	388 580	427 083	478 221	515 118	591 612	734 020
Masters	36 824	34 755	44 634	58 252	66 822	87 923	132 863
PhD	9 612	11 424	13 574	16 947	20 235	28 871	49 274
Total	**747 916**	**830 602**	**892 712**	**1 026 553**	**1 103 963**	**1 276 667**	**1 610 408**

Table 4.3: Number of Students Enrolment in Higher education institutions by level of study from 2006-2009 (Source: Tenth Malaysia Plan, 2010)

Furthermore, Mohan et al (2004) observed that the development in Malaysia tertiary education is moving towards more focused roles by the universities where there is improvement of the establishment of specialised knowledge centre that focus on R&D such as computer software, communication and biotechnology located within and near leading universities in Malaysia. Examples of this focus can be seen in the likes of the University Putra Malaysia focus on agriculture; University Science Malaysia and University Technology Malaysia focus on scientific, technology and engineering focus; and Multimedia University focus on creating a labour pool in ICT for the MSC project.

The increasing role and responsibilities of universities from the government has resulted in an increase number of universities in Malaysia from public to private university college since 1995 (Table 4.4). In total, Malaysia has 20 public universities, 28 private universities and 22 private university colleges, which are all young and under 50 years of establishment as of December 2011 (MoHE, 2011). This is probably one of the main challenges for local universities to compete with other universities in developed countries such as in the US and UK in terms of expertise in research and knowledge specialisation.

Years	Public Universities	Private Universities	Private University College
1960 – 1964	1	-	-
1965 – 1970	1	-	-
1971 – 1974	2	-	-
1975 – 1979	1	-	-
1980 – 1984	2	-	-
1985 – 1989	-	-	-
1990 – 1994	2	-	-
1995 – 1999	4	5	-
2000 – 2004	4	6	5
2005 – 2009	3	9	11
2010 – 2011	-	8	6
Total	**20**	**28**	**22**

Table 4.4: Distribution of universities in Malaysia between1960 – 2011 (Source: Malaysia Ministry of Higher Education, December 2011)

In handling this issue, the Ministry of Higher Education (MoHE) has introduced Research University (RU) status in 2006 to lead and promote universities R&D environment that has research commercialisation capability in local public universities in order to support technology and economic transformation of the country while maintaining the quality of teaching. By being recognised as RU, autonomy is given to university's Board of Directors from MoHE in various areas such as institutional operations and administration, academic administration, institutional governance, students' intake and enrolment, financial and human resource management (MoHE, 2010). There is approximately US$ 62.8 million (RM200 million) allocation for research funding for local universities to purse R&D under the National Higher Education Strategic Plan (MoHE, 2007). As of 2013, there are five public universities with the RU status; they are University Malaya, Universiti Sains Malaysia, Universiti Kebangsaan Malaysia, University Putra Malaysia and Universiti Teknologi Malaysia.

The introduction of private universities in Malaysia in 1999 such as Multimedia University (MMU), Universiti Tenaga Nasional (UniTen) and University Teknologi PETRONAS (UTP) has increase the competitive level among local universities and also to support the development of technology firms through knowledge sharing activities. The private universities also contribute to the production of quality graduates in specialities areas and to reduce the unemployment rate of graduates. According to Department of Statistics Malaysia (2011), majority of graduates from business and administration are struggling to find job after completed their studies (see Table 4.5). The contribution of private universities in providing speciality and niche areas of technology field of studies could reduce the unemployment among graduates and attract interest to industry for employability. For example the MMU was the first private university in Malaysia and located in Cyberjaya to *"serves as a catalyst for the development of the high tech ICT industry of the nation, parallel to the Silicon Valley-Stanford model in the United States"* (MMU, accessed online on September 2013). As of 2013, MMU has 13 research centres focusing in areas such as virtual reality, engineering, creative multimedia, nanotechnology, advanced robotics and business management.

Field of study	Year ('000 graduates)						
	2004	2005	2006	2007	2008	2009	Total
Business & administration	18.6	17.8	17.4	17.6	19.8	20.4	111.6
Computer & information technology	12.8	11.9	11.9	9.4	5.9	9.2	61.1
Engineering	10.6	10.0	11.1	8.2	7.9	10.8	58.6
Skill training	4.3	3.0	4.4	1.9	2.6	3.1	19.3
Social & behavioural science	2.3	3.6	3.7	3.3	2.3	2.2	17.4
Teacher training & education science	2.1	1.2	1.8	2.4	2.7	1.7	11.9
Art	1.6	1.3	1.5	1.5	1.5	0.7	8.1
Vocational	1.6	1.8	2.1	0.5	0.8	1.4	8.2
Others	10.0	12.4	11.8	8.7	10.6	13.5	67.0

Table 4.5: Distribution of unemployed graduates by selected field of study, Malaysia, 2004 – 2009 (Source: Department of Statistics Malaysia, 2011)

3.5 HIGH TECHNOLOGY BASED FIRMS IN MALAYSIA

It can be argued that small and medium sized enterprises (SMEs) have played an important role in economic development. Ajagbe et al (2012) acknowledged the importance of small and medium size enterprises (SMEs) in Malaysia since they contribute to 92% of the overall business establishments and employ more than 56% of the country's working population. They pointed to the fact that the large firms have allocated large investment in R&D of their product or services and that this has motivated small firms to be competitive in their inventions and innovation. In the Malaysian context, the National SME Development Council (NSDC) for Malaysia has defined small and medium sized enterprise through the number of employees in the organisation and their annual sales turnover.

Hobday (1995), raise a pertinent point where the rapid technological development of the newly industrialised economies (NIEs) has caught the attention of both the developing and developed economies. Lai and Yap (2004) expanded on Hobday's view and raised the point that Malaysia and the NIEs share an almost identical economic regime and trade structures. It has also been discussed in earlier sections the importance placed by the government of Malaysia on technology and innovation development within the country. It is therefore not a surprise to find that strategies put in place by the government including its policies have been designed in such a way that technology and innovation strategy features prominently. Authors such as Dodgson (2000) and Chang and Cheema (2001) put forward the same view where they observed both Malaysia and the NIEs as having put in place a structure where they can identify and act on strategic technologies to their advantage. This can be seen from the discussion of the Planning Horizon and economic growth of the country earlier in this chapter. One of the main reasons behind this is to attract foreign MNCs to locate their firms in Malaysia. Notwithstanding that objective alone, the government of Malaysia has also deemed to try and encourage the development of high technology small firms (HTSFs) in Malaysia. The inability to act could lead to Malaysia being seriously disadvantaged in international competition as noted by Freeman and Perez (1998).

The role of government in Malaysia and the SME business strategy (Hashim and Hassan, 2008) encourage the development of the SME sector as can be seen from the National Economic Policy and the Malaysian Development Plans (the five-year plans presented in the Planning Horizon section earlier). In realising the vision 2020 and to transform Malaysia into a high technology nation, the government has identified that ICT and biotechnology also have potential development in Malaysia. Lall and Teubal (1998) work also suggest that Malaysia have used trade and domestic policies to influence resource allocation, infrastructure development, technological activity and FDI attraction in strive to increase local technological capabilities.

			(RM Million)	
Year	**Abroad**	**In Malaysia**	**Total Investment**	**Net Direct Investment**
2001	31746	129093	160839	-97347
2002	38855	142661	181516	-103806
2003	45671	156514	202185	-110843
2004	48619	163578	212197	-114959
2005	83292	168057	251349	-84765
2006	127582	189676	317258	-62094
2007	193217	250509	443726	-57292
2008	231833	254955	486788	-23122
2009	272805	270517	543322	2288
2010	298988	313346	612334	-14358
2011	338186	365558	703744	-27372
2012	368200	404911	773111	-36711

Table 4.6: Malaysia's direct investment in abroad and local from 2001-2012 (Source: Department of Statistics, Malaysia, 2012)

Following to the effect of Asian financial crisis in 1997, the total direct investment was back to project the growth and the government start to invest more in local development than foreign investment at the start 2001. This was when the MSC project was in the first 5 years development and massive local infrastructure investment was put in place. The investment was almost double of the total investment figure in 2004 as compared to 2001 (Table 4.6). At the start of this, the technology firms are encouraged to protect their product or services through patent and trademark. The number of intellectual property (IP) for Malaysia was small in the early 2000s but start to increase in 2006 onwards (Table 4.7). Among these IP filing, the ICT industry contributes the highest amount of applications received for Malaysia and biotechnology industry was among the lowest (Table 4.8) filed according to WIPO (2013).

Year	Patent	Trademark	Industrial design	Total
1997	194	9,158	-	9352
1998	205	4,121	-	4326
1999	231	5,130	111	5361
2000	227	6,590	286	6817
2001	300	7,258	510	7558
2002	349	9,147	540	9496
2003	721	10,230	778	10951
2004	918	11,802	775	12720
2005	922	11,877	761	12799
2006	1,010	14,058	1,118	15068
2007	1,179	15,930	1,245	17109
2008	1,361	15,740	1,294	17101
2009	1,812	16,552	1,250	18364
2010	1,937	17,786	1,069	19723
2011	1,947	16,678	1,285	18625
Total	**13,313**	**172,057**	**11,022**	**185370**

Table 4.7: IP filing for Malaysia: Patent, Trademark and Industrial design (Source: WIPO statistic database, May 2013)

Field of Technology	Share (%)
Computer technology	6.80
Furniture, games	5.72
Civil engineering	5.40
Other special machines	5.14
Semiconductors	4.98
Electrical machinery, apparatus, energy	4.78
Basic materials chemistry	4.64
Handling	4.30
Food chemistry	3.63
Pharmaceuticals	3.63
Others	50.98

Table 4.8: Patent applications by top fields of technology between year 1997-2011 (source: WIPO statistic database, May 2013)

4.5.1 ICT in Malaysia

The development within the past decade has seen the ICT sector moving away from sole control of firms in developed countries. There are now an increasing number of firms from the NIEs becoming major players within the ICT sector (Correa, 1996; Heeks and Nicholson, 2004). Malaysian ICT firms therefore face strong competition from other NIEs (Correa, 1996) for a share of the ICT market. It is therefore important that the government provide extensive support to these firms in order to give them the ability to compete internationally. Multimedia Development Corporation (MDeC) is a corporation that was funded by the Ministry of Finance and under supervision of Ministry of Science and Technology and The Prime Minister Office to overlook the development of ICT industry in Malaysia. The MSC Malaysia Impact Survey result of 2008 increase in sales, revenue, exports and jobs created (MDeC, 2008). It was estimated by the MDeC that MSC Malaysia contributed 2.66% of Malaysia's GDP. Further information of ICT in MSC will discuss in Section 4.6.

4.5.2 Biotechnology in Malaysia

Biotechnology is a commercial sector providing high world-wide growth and is perceived by many as a source of considerable wealth generation despite it being a relatively young industry (see for example Bower, 2003; Deed s et al, 1998; Mirasol, 2006; Nagle et al, 2003; Strupp, 2006). It is regarded as having excellent potential for local economic generation and regeneration (Baker, 2003). Pisano (2006) stressed that biotechnology is not just another high tech industry and as such it requires rethinking of strategy, policy and new anatomy. Ahn and York (2011) questioned whether "traditional cluster models of industry development are a good fit" for Malaysia's technology transformation. This view is particularly important as unlike other industries, biotechnology products take far more time and capital to bring to market, thus requiring unusual levels of effective patent exclusivity and incentives for research and development (Azoulay, Michigan and Sampat, 2007).

Malaysia has targeted biotechnology as a national priority to enhance productivity and sustainability, as well as build wealth and economic growth. In 2005, the National Biotechnology Division (BIOTEK) was established under the supervision of Ministry of Science, technology and Innovation (MOSTI) to lead the biotechnology development in Malaysia including R&D, human capital, marketing and public understanding. The

Ninth Malaysia Plan allocated over US$1 billion to biotechnology industry development in Malaysia (2006–2010), as well as the National Biotechnology Policy and Third Industrial Master Plan (2006–2020), to spur sector growth. To achieve this, the Malaysian government has replicated the same model used for the development of ICT policy in Malaysia and established the Malaysia Biotech Corporation to coordinate biotechnology industry activity in the country. Interestingly, a similar initiative to the MSC Status Companies status was also introduced in the form of The Bionexus network where firms receive special government support (see Appendix 2). The focus of this is to support on a diverse group of biopharmaceuticals, biofuels, diagnostics, and agricultural biotechnology companies. The approach is different to other NIEs as Malaysia has had to capitalize on its own capabilities (Martino, 2006). Ahn and York (2011) praised the forward thinking governmental approach which is quite consistent with Barney's (2001) resource-based view and Porter's (1990) diamond model.

4.6 MSC AS THE CASE STUDY

The Malaysian government has recognised the cluster-based development approach as one of the strategic development tools for the growth of its economy. There are selected geographical areas identified as Free Trade Zone (no duty tax on products and services) which aims to boost the growth of local industry cluster especially the tourism industry in areas such as Labuan Island, Langkawi Island and Tioman Island. Furthermore, there are five new growth corridors identified during the Ninth Malaysia Plan (for year 2006 – 2010) which includes objectives to balance the regional economic development and focus growth in the selected industry cluster and geographical areas. According to the Tenth Malaysia Plan (for year 2011 – 2015), Malaysian government has identified the potential economic cluster in selected areas, also known as National Key Economic Areas (NKEAs) of each of these five corridors have the economic and geographic advantages: (1) Iskandar Malaysia is to focus on education, healthcare, finance, creative industry, logistic and tourism industry -launched 2006; (2) Northern Corridor Economic Region (NCER) to focus on agriculture, manufacturing and services, tourism and logistics industry – launched 2007; (3) East Coast Economic Region (ECER) to focus on tourism, oil, gas and petrochemical manufacturing, agriculture and education industry – launched 2008; (4) Sarawak Corridor Renewable Energy (SCORE) to focus on heavy industry i.e. aluminium, glass, steel and timber industries, agriculture and aquaculture related industry, marine engineering, and tourism industry - launched 2008; (5) Sabah Development Corridor (SDC) to focus on tourism, manufacturing (palm oil and related products), oil and gas, agriculture and logistic industry - launched 2008.

Other than the five corridors or regions mentioned earlier, focus is also given to the area called Greater Kuala Lumpur (Greater KL) cluster announced in Economic Transformation Programme in 2010 where this geographic areas contributes eight times the Gross Domestic Product (GDP) of any other city in Malaysia (EPU, 2010) and cover the areas of Kuala Lumpur (capital city of Malaysia) and its neighbouring cities, previously known as Klang Valley. Parts of Greater KL, an engineered cluster of Multimedia Super Corridor (MSC) was located and created in 1996 to spur the economic growth and introduce information and communication technology (ICT) industry as an industry that can move Malaysia towards high technology industry with talented skills while attracting foreign investment. MSC was among the first regional economies project to concentrate on the ICT industry.

4.6.1 Multimedia Super Corridor (MSC) Malaysia Project

Inspired by the success of Silicon Valley in California, coupled with the intention to be a developed nation under its Vision 2020 initiatives, the policymakers in Malaysia established the Multimedia Super Corridor (MSC) also known as MSC Malaysia in 1996 with a mission to transform Malaysia into a high-technology zone and knowledge-economy. In line with this project, the Malaysian government established the Multimedia Development Corporation (MDeC) to develop, facilitate and oversee the MSC Malaysia project. The MSC covers an area of 50 x 15 km^2 zone, stretching from the PETRONAS Twin Towers in Kuala Lumpur which also referred to as the Kuala Lumpur City Centre (KLCC) to the Kuala Lumpur International Airport (KLIA). This zone includes Putrajaya (the official seat for federal government), Cyberjaya (national hub for information and communication technology (ICT); and research centre), Multimedia University, MSC Central Incubator (focusing on IT and multimedia) and Technology Park Malaysia (focusing on ICT and biotechnology). The development of the MSC is spread out over three phases of covering a period of 25 years (1996 – 2020) as shown in Table 4.9.

The concept of MSC also being established to promote healthy linkages among actors in Porter's Cluster concept and the Triple Helix's innovation concept that could drive the innovation contribute to competitive advantage of nations and create sustainable economic growth. However there are challenges for Malaysia to pursue this project and it is of interest to this research to explore the high technology firms located within the MSC cluster. The Malaysian government has introduced a series of incentives to attract investors (including in the 10 Bill of Guarantees (BoG), (Appendix 1). The performance of BoG and the MDeC as the development agency is indicated in the following survey.

	Phase I (1996 – 2004) Create Multimedia Super Corridor	Phase II (2004 – 2010) Link MSC to other cyber cities in and outside of Malaysia	Phase III (2010 – 2020) Transform Malaysia into Knowledge-society
Target Milestone	• 1 corridor. • 50 world-class local companies. • Launch 7 flagship applications. • World leading framework of Cyberlaws. • Cyberjaya as world-leading intelligent city.	• Web of corridors. • 250 world-class companies. • Enhance current flagship applications and introduce new one. • Harmonisation of global framework of Cyberlaws. • Enhance local ICT industry. • Link 5 intelligent cities to other global intelligent cities.	• 500 world-class companies. • Global test-bed for multimedia application. • International Cybercourt of Justice in MSC. • 12 intelligent cities linked to one another.
Achievements to-date	• Build a corridor ranging from KLCC to KLIA. • 742 companies (10 strong performers and 50 foreign and local MNC's were awarded MSC Status). • 7 flagship applications were launch before end of Phase I. • Comprehensive set of Cyberlaws were enacted but Personal Data Protection Act are still pending • More focused on development of physical infrastructure in Cyberjaya while social infrastructure was not at the same pace	• 7 Cybercities and 8 Cybercentres have been created while southern and eastern corridors are still undergoing development • As of October 2008, 2173 companies in total have been awarded MSC Malaysia status while 9% from this number were inactive. • Flagship applications that were launched are still in enhancement process of its potential (Electronic Government, MyKad, Smart School and Telehealth) and there have been no new flagship launched. • ICT related laws especially IP-protection right have yet be adequately enforced	• In the hope by end of Phase III Malaysia will be transformed into Knowledge society

Table 4.9: The development plans and achievements of MSC in between 1996 to 2020

(Source: Official website of MSC Malaysia (www.mscmalaysia.my) and the National IT Council (www.nitc.org.my)

4.6.2 MSC Impact Survey

In 2002, MDeC created the MSC Malaysia Impact Survey to monitor the performance of the MSC Malaysia Status companies. The results of the survey will be used for the development of the MSC Malaysia Status Companies. Based on the MSC Malaysia Impact Survey 2008, majority of the companies are from the area of application software (46%), followed by mobility, embedded software & hardware - MeSH (19%), internet-based business (11%), creative multimedia companies (10%), shared services & outsourcing (9%) and Institute of Higher Learning (IHLs) and Incubators (5%). Among these five clusters, shared services and outsourcing cluster has contributed the highest MSC Malaysia revenue which was 5.34 billion of Malaysian Ringgit (MR) or 31.27% of total revenue in 2007; meanwhile, IHLs and Incubators only contributed MR0.916 billion of MSC revenue. As overall, the MSC Malaysia Status companies have contributed 1.2% of GDP to Malaysian economy. The survey also indicated that the rapid growth at Compounded Annual Growth Rate of 22.46% from 2003 to 2007 (excluding the IHLs and Incubators have had this cluster data only start collected from year 2006). However, IHLs & Incubators had a substantial growth in research and development expenditure which accounted 68% increment from 2006 to 2007; and the shared services and outsourcing cluster also had achieved the higher growth of expenditure with total of MR608 million in year 2007. Furthermore, IHLs & Incubators have a higher competitiveness potential at local level (43%) but has a lower rate at global level (14%). In comparison with other cluster in terms of competitive potential at global level, shared services and outsourcing, multimedia and MeSH, internet based business and application software achieved 43%, 27%, 28%, 19% and 18% respectively. The results from the impact survey 2008 have concluded that IHLs and Incubators cluster have a potential to grow in spite of its huge R&D expenditure to Malaysia economic development.

4.6.3 Research on MSC Malaysia

There are not many research papers published on MSC Malaysia at the moment compared to Silicon Valley. Many literatures discussed in earlier chapters of this research agreed that the success of Silicon Valley was due to the concept of clustered-based industry. Apart from government role, it was identified that there are four major important elements that support the success of Silicon Valley. They are culture, university-industry relationship, technology and infrastructure and venture capital. The success has inspired many developing countries such as Thailand, India, China and

Malaysia to develop their own version of Silicon Valley. Malaysia has created the MSC Malaysia in 1996 to push the country's technological capabilities in order to achieve a sustainable and competitive economy as well as the goal of becoming a developed nation by year 2020.

Tidd and Brocklehurst (1999) research on MSC identified two major weaknesses in Malaysia's innovations policy which are lack of strategic intent to exploit alliances; and lack of indigenous expertise (knowledge and skills). However, the government's role in creating MSC Malaysia project has shown some effort for developing the technological learning of the nation.

Ramasamy, Chakrabarty and Cheah (2003) reported progress on the MSC Malaysia but it is lacking in intangible factors such as entrepreneurial spirit that could threaten the success of the project. The researchers also criticise the culture of risk-taking among Malaysian (culturally Malaysians are in general risk averse) which they felt that the government needed to tackle, even though there are sign this is changing. They also reported on entrepreneurs in Malaysia have low satisfaction level and display negative attitude towards failure compared to Silicon Valley where entrepreneurs are reported to take a high level of risk. The skills gap among Malaysian was also found to be limited in this research and need to be resolved in order to attract more investors.

Malairaja and Zawdie (2004) discovered that the MSC project has increased the joint-venture activities in Malaysia especially in information and communication technologies (ICTs) industry. However Malaysia still facing the ineffectiveness of international joint-venture technology transfers. This research has identified two main factors due to ineffectiveness of innovation and technology transfer in Malaysia which are learning gap (knowledge and skills readiness) and institutional gap (organisational and cultural framework). There is weak link between technology transfer practices and decision to innovate. The research also suggests that government need to enhance local technological development in its policy for innovation, and strengthen the links between institutions, research institute and private firms (triple helix culture). Adequate venture capital's investment and infrastructure support are also needed to help stimulate the development of technological readiness at enterprise level.

Kaliannan, Awang and Ramli (2007) found that the MSC has improved the operational and management process in the government services through the E-government initiative. Also, the initiative shows some improvement on the transparent process of procurement, reducing bureaucracy when dealing with the government agencies as well as improving relationship between the buyer (government) and suppliers (local firms). However challenges occurred on issues such as cost to be government's supplier, limited skills in basic computing and information system amongst supplier and suppliers reluctant to change in business management from traditional to on-line business.

Jarman and Chopra (2007) claimed that the MSC has contributed towards relocations of larger multinational organisations as a suitable location for business services and call centres rather than the targeted "multimedia hub" type of operations. They both argued that the reasons behind this situation are because Malaysia is less capable as developing country to attract high-end operations in R&D, the lack of human capital to absorb the technological change for the development of knowledge economy and the lack of depth understanding on the concept of knowledge economy among developing countries. In their research paper work, they argued that the knowledge economy in Malaysia is progressing slowly due to the fact that the business services industry in MSC is considered as "an integral part of knowledge economy, albeit at the lower end". They also argued that the absorptive capacity in high level knowledge economy requires a high quality university graduate which was lacking at the moment.

4.7 CONCLUSION

This chapter has discussed the condition of Malaysia's economic development with the role of government in formulating and adopting various national policies such as NEP, NDP, NVP, NEM and most importantly the Vision 2020. Following to this, a summary of Malaysian economic planning horizon and policies were illustrated in Table 3.2 to give an overview of the country strategic planning over time. The condition of Malaysia's NIS was also presented with focus on the universities and technology firms supported with statistical report from various useful sources.

The growth concern of universities as important institutions can be claimed to be because of the country facing a shortage of science and technology human resources in the 1990s. Government policies of investing in education and R&D were put in place to reduce the gaps. By 2011, the total of universities in Malaysia was 68 (i.e. private, public and private university college) a massive increment from 7 universities in 1990. Despite the positive growth of higher academic institutions, the universities are facing greater challenge in improving the education system, quantity and quality of talent in S&T and aligning the demand from industries and governments for economic and social contribution.

An overview of Malaysian technology industries (ICT and Biotechnology) was also highlighted in this chapter. The role of government intervention in the industries has seen been the major contribution in its growth resulting from innovative policies and investment. As a result the total number of IP filing (i.e. patent, trademark and industrial design) in year 2011 increased by 49.7% since 1997. However, there were concerns as to the capabilities of the local technology firms to survive and grow at the current pace of technological advancement, which the country is still far behind and needs to catch-up. The context of this research on MSC (i.e. engineered technology cluster) as the case studies was also presented with some criticism of the MSC development from other scholars who have investigated the phenomenon of MSC. Then the overall development of Malaysia based on type of investment (FDI and local investment), labour force, education level and IP filing was presented in Figure 4.1 along with the year of important policies and projects that were announced in the country.

It can be summarised from previous research that there are: (1) gaps in knowledge and skill among locals; (2) a low level of institutional link even though progress has been made; (3) ineffective innovation policies; and (4) the influence of local culture are among the factors slowing down the progress of the MSC project. This indicates the weakness in the innovation system of the country. At the same time, there is limited information available on the components of firm formation and cluster analysis of MSC. At present, there is little research done on the role of university, industry and government through collaborative relationship for the firm formation within MSC. Thus, the research is interested to focus MSC as the case context of study and examines the collaborative relationships of key factors engaged within and/or around it.

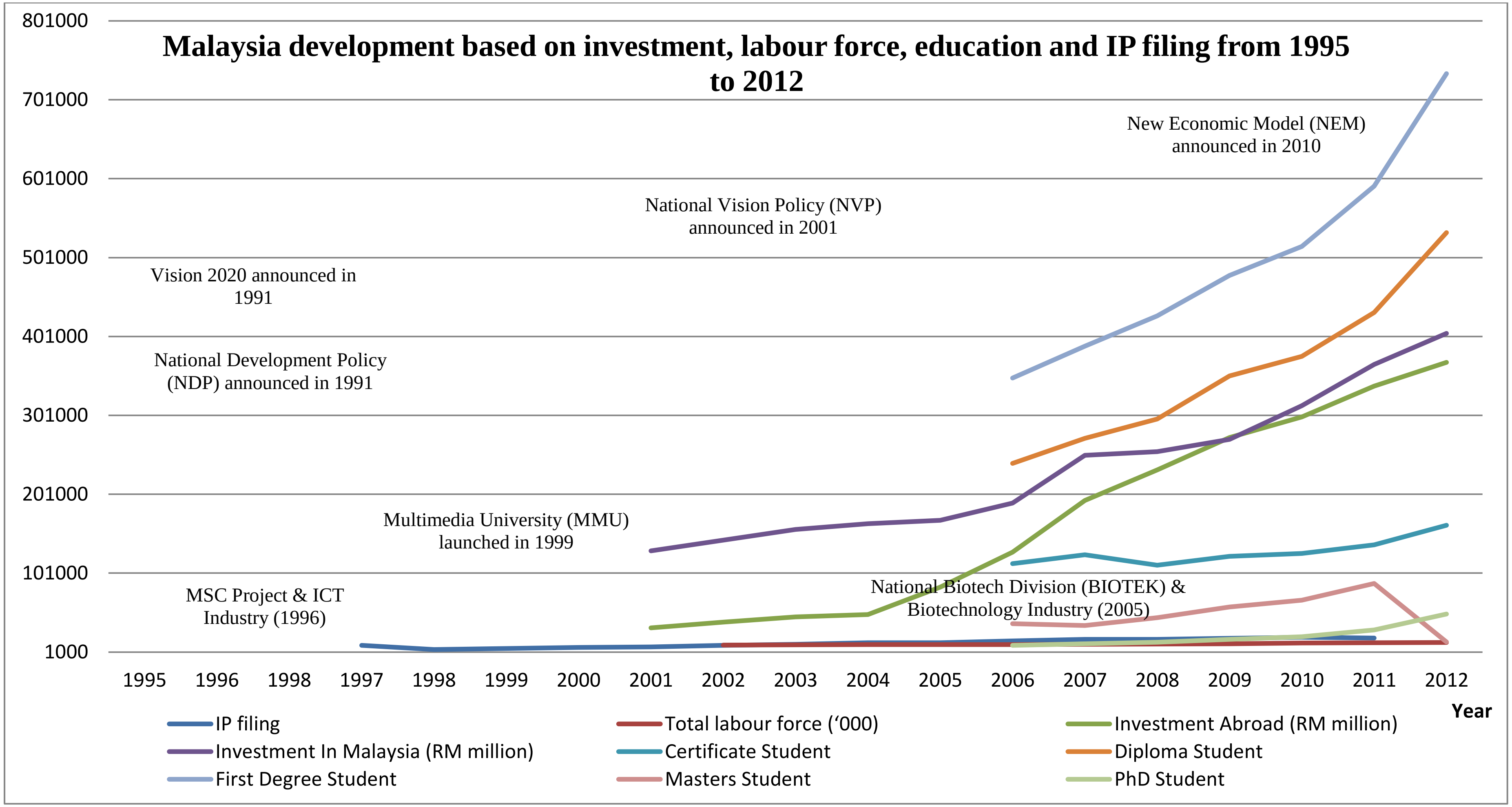


Figure 4.1: Malaysia development based on investment, labour force, education and IP filing from 1995 to 2012 (Source: author)

CHAPTER 5

METHODOLOGY

5.1 INTRODUCTION

This chapter discusses the practical approach to establish the research methods that are best suited to address the issues of the research questions. This chapter outlines various considerations pertaining to the relevance methods that could be used in this study and will identify the research tools and instruments that are available. The research was organised systematically and the route of research stages for this investigation was presented in Figure 5.1.

There are ten stages involves and start with the formulation of general research questions and objectives (Stage 1). Following to this, Stage 2 is the exploration of the related literature and concepts from the innovation and cluster studies (Chapter 2) to the specific research context i.e. Malaysia (Chapter 4) that contributed to the formulation of the conceptual model of this research (Chapter 3). Stage 3 involved the process of refining the research questions and objectives based on Stage 2 and Stage 3 so that the investigation is more focus on the context of the investigation. Following to this, Stage 4 is the research philosophy, while Stage 5 is the research design that both were need to be considered prior collecting the data. Once the research approach has been chosen, the data collection begins with the survey instrument (Stage 6) and the survey output was derived from the use of statistical analysis program (Stage 7). The output from survey, literature, conceptual model and research question provides initial indication for the second data collection process, interview instrument (Stage 8). The interview data were analysed and discussed (Stage 9) based on Stage 2, 3 and 6 so that the meaning of the research investigation can be summarised and concluded (Stage 10).

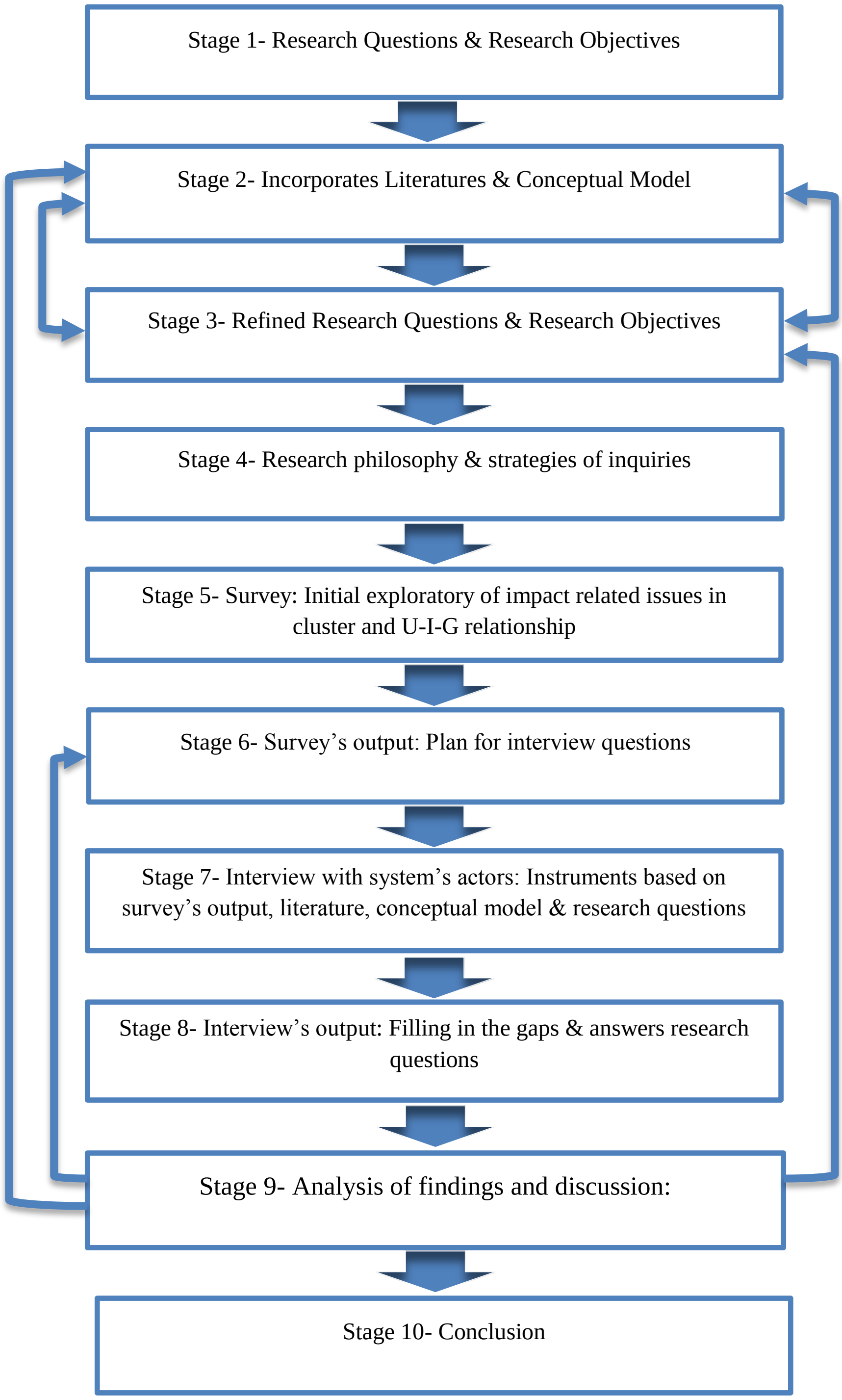


Figure 5.1: Routes of research stages of the study (Source: author)

5.2 RESEARCH QUESTION AND OBJECTIVES

It will be useful to reiterate the research questions, established earlier in Chapter 1. This investigation seeks to answer the following research question:

> "What are the factors and institutional collaboration determinants for successful cluster development and how do they fit the engineered MSC Cluster?"

The objectives of this research are to:

1. Research Objective 1 (RO1)

   Explore and investigate the factors (determinants) for the development of firms in a cluster.

2. Research Objective 2 (RO2)

   Examine the factors that influence firm growth in the cluster: the collaboration effect including motives and barriers.

3. Research Objective 3 (RO3)

   Understand the nature and role of university, industry and government; and its relationship in cluster development (MSC Cluster).

4. Research Objective 4 (RO4)

   Identify the primary determinant condition factors that make the MSC cluster different from organically formed clusters.

5.3 RESEARCH PHILOSOPHICAL FRAMEWORK

The identification of philosophical underpinning the research is important in order to set the foundation of research strategy in relation to the researcher's views of the development of knowledge and the nature of the knowledge itself. This system of thinking helps the researcher formulate an appropriate research strategy and method (Saunders et al., 2009) but is also able to help answer the research questions. Based on the research question presented, it can be summarised that this research is not limiting the worldview from one aspect of a particular paradigm but instead it fits with multiple views and a pragmatic approach. There are three ways to understand the philosophical view of this research. Firstly, epistemology is concerned with the nature of the knowledge and truth i.e. testing the relationship of the reality and the research context (Bryman and Bell, 2007; Somekh et al., 2005; Saunders, Lewis and Thornhill, 2009). Secondly, ontology is concerned with the real nature of the world or reality i.e. judgement of the social entity (Carson et al., 2001; Bryman and Bell, 2007; Saunders, Lewis and Thornhill, 2009). Finally, axiology is concerned with the values i.e. judgement of the research itself which includes ethics (Somekh et al., 2005; Saunders, Lewis and Thornhill, 2009). Therefore, it can be said that there are three parts of paradigm that needs to be understood within the scope of this research: (1) positivism that focuses on fact and attempts to find causal relationship and explanation; (2) realism that focuses on reality and belief that already exist; and (3) interpretivism that focuses on meaning and understanding on the specific research context and attempts to evaluate in detail (Kasi, 2009; Saunders, Lewis and Thornhill, 2009; Easterby-Smith et al., 2008; Cooper and Schindler, 2006).

The research focus of this study is to look at the collaborative relationship of actors in the context of cluster development in Malaysia. Firstly, this requires identifying the determinants that contributes towards the development of cluster, the collaboration capability including the causal motives and barriers of having collaborative relationship in cluster and identifying the role of actors in the cluster. This means that the research is to focus on facts, causes and the adoption of theory (i.e. cluster) in a Malaysian setting.

All of these fit in the positivism paradigm. Secondly, this requires an in depth understanding of the meanings and explanation of the impact of the determinants in cluster, the influence of collaboration in cluster development and the nature role of actors (i.e. university, industry and government) in supporting the cluster development in Malaysia. This means that the research takes a stance on interpreting and understanding the meaning of the research subjects which fit in the interpretivism paradigm. Therefore, the philosophical framework of this research is such that it takes on a pragmatic approach where it consist the mixture adoption of positivist and interpretivist worldview that concerned with the epistemology assumption.

5.4 STRATEGIES OF INQUIRY

Following the understanding of the philosophical framework of this research, a strategy of inquiry was conducted to answer the research question and meet the research objectives. The following sub-sections will discuss these varying approaches in order to justify the chosen approach of this research. Prior to this, pragmatic research strategies will be considered to guide this research, inform a clear research design and select appropriate methods that can be used for the investigation.

- *Pragmatic Research Strategies*

This research study is not bound to one strategy but is considering others that are appropriate to answer the research question in a pragmatic view. The approach of the investigation considers three main strategic line of inquiry which are case study, grounded theory and survey. A case study according to Yin (2003) is a comprehensive research strategy that does not distinguish any preferred form of data collection but is interested in studying the phenomenon of a particular context. Thomas (2011) and

Creswell (2009) explained that a case study provides the phenomenon being studied with more in-depth and proximity to problems to understand the “how” and “why” of the situation. While Robson (2002) explained the case study involves the empirical investigation that uses various approaches or methods to collect sources of evidence i.e. data that can lead to answers to the research question. This means that a case study is exploring the phenomenon (Creswell, 2009; Bryman and Bell, 2003; Zikmund, 2000) and seeking further explanation on causal relationship or something that has happened which concentrates on a single event, institution, group, region or country in detail. Multiple sources of data provide validity of the research investigation through triangulation (Saunders et al, 2007). In relation to this research, Malaysia is the context of this study and more specifically will concentrate on the Multimedia Super Corridor (MSC) as a case study of the phenomenon of an engineered cluster.

In grounded theory, emphasis on the development of theory with a combination of both inductive approach (building theory) and deductive approach (testing theory) to provide an indication and explanation of the behaviour of the phenomenon being studied (Quinlan, 2011; Saunders et al, 2007; Goulding, 2002). It also involves the collection of data from various sources (Quinlan, 2011; Creswell, 2009; Saunders et al, 2007) as in a case study approach to build robust data that can inform the theory between the theoretical and practical implication (Quinlan, 2011). A grounded theory approach is used when there is limited literature (in some cases there is no literature review) on the phenomenon, thus gives difficulties to the researcher in providing early ideas about what to be expect in the data (Quinlan, 2011). In relation to this research, the concept of clusters in innovation and triple helix theory were used to guide the investigation and lead to the development of the conceptual model which later is used in the context of the case study (MSC). Thus, the approach for this study can be considered as combination of deductive and inductive approaches. Analysis of data in this investigation would indicate whether the conceptual model fits to the case context and thus addresses the research question (Section 5.2). Furthermore, there is limited literature on the development of engineered clusters (MSC) from the developing countries perspective, as most literature on successful cluster cases are from developed countries such as US, UK, France, Germany, Finland and Japan. This was highlighted in Section 1.4 as a gap in the current literature on regional development studies.

The longitudinal studies can be describes as the research that takes over long period of time to study on change and development of individual, institution, phenomenon or behaviour (Quinlan, 2011; Saunders et al, 2007, Bryman and Bell, 2003; Pole and Lampard, 2002). This type of research strategy provides rich type of data collected and thus has potential to develop and test of particular theory employed (Saunders et al, 2007). According to Pole and Lampard (2000), longitudinal studies does not necessarily involves long periods of time but can be in short periods, where the data collected at two different occasion i.e. before and after involves on some event or situation. In relation to this research, the longitudinal studies can be considered as the strategies of inquiry as the phenomenon of the investigation involves the development of MSC from it was first launched in 1996 and today progress. The data collection may not involves longer period of time but interesting to look at the changes of its development by using determinants that were found important on the success of Silicon Valley and Cambridge as well as documented in literature. The secondary data such as economic and statistical report for example IP filling, labour force and education level could be used to investigate the changes of the MSC development over period of time. This probably fall back on the view of pragmatic research approach that are trying to consider as much appropriate approaches that can be used to answer the research question of the study.

5.5 RESEARCH DESIGN OF THE STUDY

The purpose of research design is to get clear indication on the overall framework and plan of the investigation which involves the philosophical view, research approaches, strategies and method of data collection that interconnected with the conceptual model of the studies to addressed the research question and objectives (Quinlan, 2011; Creswell, 2009; Saunders et al, 2007). There are six stages involves in the plan for this investigation (Figure 5.2). The following section explains each of the stages involved.

5.5.1 Stage 1: Designing the Research Question and Objectives

Generating the research question and objectives of this study involved a review of the literature journals, articles, books and reports; related theories and concepts of the research topic and also created the conceptual model (Figure 3.11) of the study. This is the important stage because it serves as the main focal point and first step before the conceptual, theoretical, methodological and analytical framework can begin (Quinlan, 2011). There are two processes involved in designing the research question and objectives of this research (Figure 5.1). The first process start with the identifying the research idea of interest to study and the research questions were based on issues or gaps found in the literature and conceptual model (Chapter 3). At this stage there are many potential research questions and objectives that relate to the subject area. In relation to this study, the research interest is on cluster development and the collaborative relationship between university, industry and government in cluster.

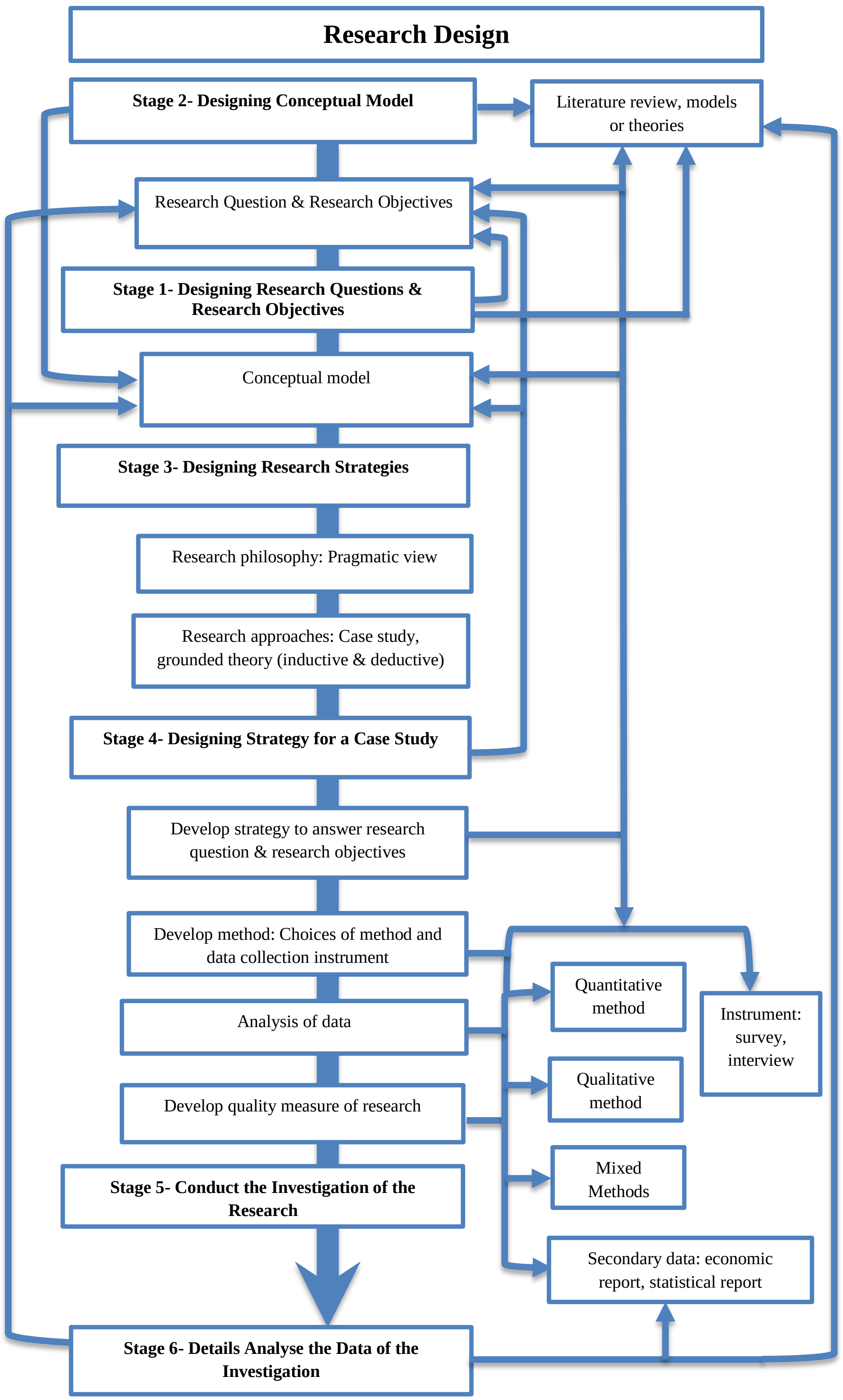


Figure 5.2: Research design framework of the study (Source: author)

The second process starts when the focus of the research project or context has been narrowed and defined so the research questions and objectives were refined to create a clear focus on context and within the boundaries (i.e. time and resources) of the research undertaken (Quinlan, 2011; Easterby-Smith at el, 2008; Saunders et al, 2007; Bryman and Bell, 2007). This is because the research study cannot answer all of the potential research questions, thus the most relevant to the context and capability to investigate were selected (Bryman and Bell, 2007). Considerations of previous research also identified on opportunity for the uniqueness of this study. For this research, the context is Malaysia, and the MSC as a case to be investigated.

5.5.2 Stage 2: Designing Conceptual Model

A conceptual model of this research context (Figure 3.11) was designed based on the literature review (i.e. innovation, cluster – regional studies, Malaysia, MSC) related models or theories of cluster formation (i.e. NIS, Porter's Diamond model, Triple Helix theory, business networking and collaborative innovation); and research question and objectives of the studies. The purpose of having a conceptual model is to provide a clear focus of the study such as the scope of the literature search (Quinlan, 2011), strategy for the approaches and method to be used for data collection, strategy to analyse the collected data, and most importantly, to answer the research question and objectives. The conceptual model also serves as one of the research contributions in the cluster development's literature and can be used as a strategic framework for policy makers in planning for their regional development polices. A detail design of the conceptual model was discussed in Chapter 3.

5.5.3 Stage 3: Designing Research Strategies: Pragmatic Research Approach

In this stage, appropriate strategies were considered and planned to achieve the overall investigation, organise the structure of the investigation and manage the quality of the research, which leads to answering the addressed research question and objectives. At the beginning, the research philosophy will underpin the research design on how the researcher's views can influence the conduct of the investigation (Bryman and Bell, 2007) and it can be understand from epistemology, ontology or axiology assumptions. Through each of these assumptions, the philosophical view includes positivism, interpretivism, constructivism and pragmatism. The research strategy can be used in any purpose of the research i.e. exploratory, descriptive or explanatory which can be identified from the research question itself (Saunders et al, 2007). For this research, pragmatism was the philosophical view that underpinning the research strategies of this research which believed that the research question can be answered by using more than one strategy. Details of the philosophical framework of this research were discussed in Section 5.3.

Apart from philosophical view, the type of approaches also was considered in designing the research strategies so that the investigation is relates to the context and appropriateness of the method use. The choice of the approach provide specific guideline and format to conduct the investigation so that it focus on the context and meet the research question and objectives set for the study (Creswell, 2009). The choice of approaches includes survey, experiment, ethnography, grounded theory, case studies and phenomenological. For this research, the context was cluster development in Malaysia with MSC as a case study of the engineered cluster and uses the actors from the triple helix theory as the sample research. The conceptual model, research question and objectives were used as the main reference and focus. The grounded theory approach also was considered in this case study research as it employs cluster and triple helix theory (deductive approach) in the investigation along with the conceptual model (inductive approach). Details of the strategy of inquiry on research approaches of this investigation were discussed in Section 5.4.

5.5.4 Stage 4: Designing Strategy for a Case Study

As the approach used was a case study, the research strategy concentrated the investigation within the case itself. There are four strategies involves for the case study (MSC), they are the plan to develop on how to answer the research question and objectives; what are the choices of the method that can be used; how to analyse the data collected; and how to measure the quality of the research.

The ultimate goal for this research strategy is to answer the addressed research question. In doing this, there are four research objectives to guide the investigation with the support from the conceptual model, literature review and analysed collected data from the actual case (MSC). Each of the research objectives requires various types of information from different resources i.e. primary data or secondary data. Thus requires plan to develop an appropriate method of data collection. For this research, primary data (survey and interview data) would be the main resources as it reflects to the specific case and there are no available data to acquire. The secondary data were used to support primary data to answer the research question (Saunders et al, 2007) and the source can be in the form of economic and statistical reports of Malaysia as the context and MSC as the case study of the context studied. Details of strategy to answer the research question and objectives of this investigation were discussed in Section 5.10.

As the primary data was considered important to answer the research question, it is necessary to plan and develop appropriate method that can be used to collect the desired data that are valid and reliable (Saunders et al, 2007). This involves the strategy of method selection which includes the consideration of available choices that can be used and the justification of the chosen method. According to Saunders et al (2007), Creswell (2009) and Quinlan (2011), the choices of methods can be quantitative method (normally generate or use numerical data), qualitative method (normally generate or use non-numerical data) or mixed methods (combining quantitative and qualitative method). As this research employed pragmatic research strategies approach, both quantitative and qualitative data were considered useful and the choice of method used was mixed method data collection. The details of the choices of method and justification of chosen method of this investigation were discussed in Section 5.6 and Section 5.7 respectively. The research sample also being identified to reflect the appropriate of data validity and reliability and for this research, Section 5.8.1 discussed the sample of the method used. The instrument or technique of the chosen method was also considered in the research strategy. Creswell (2009) describe that each method used for research has different type of instruments as displayed in Table 5.1. For this research, the survey instrument has been used for the quantitative method while interview for the qualitative method. Details of the survey instrument including the structure of the self-administered questionnaire were discussed in Section 5.8.2. For interview instrument details were discussed in Section 5.8.3 including the structure of semi-structure questionnaire.

The data collected then need to be analysed with the appropriate techniques so that the meaning of the data can provide summary to answer the research question and objectives (Easterby-Smith et al, 2008). For this research, the analysis for the survey data was used with the statistical technique of the Predictive Analytics Software (PASW) that can provides descriptive statistics and the Mann-Whitney U test for significant differences between two groups of sample. Details of the strategy of inquiry on analysing the survey data of quantitative method were discussed in Section 5.9.1. In relation to the interview data of qualitative method, the content analysis was used by using the coding and themes technique so that the generalisation and summary of the data can derive meaning to answer the research question and objectives. A triangulation approach was used so that both quantitative and qualitative data can be corroborating with each other. Details of the strategy of inquiry on analysing the interview data of this investigation were discussed in Section 5.9.2.

Quality measure of research method also takes into consideration during the designing and planning stage of the case study. This to provide sound method use for the research that can lead to produce reliable and credible data or information to answer the research question and objectives (Saunders et al, 2007). For this research, the quality measure were include pilot testing, reliability and validity of the data and analysis used for both quantitative and qualitative methods, and ethical issues in conducting research. Details of the strategy of inquiry on quality measure of this investigation were discussed in Section 5.8.4.

5.5.5 Stage 5: Conduct the Investigation of the Research

This stage involves the strategy to conduct the primary data collection for the chosen methods i.e. quantitative and qualitative method. Consideration was look into the appropriate instrument used to collect the data as it will affect the response rate and the reliability and validity of the data for the research (Saunders et al, 2007). For survey research, questionnaire was commonly use in business research (Saunders et al, 2007) however it is important to ensure the survey employs the good questionnaire design (Pole and Lampard, 2002) so that questions ask are focus to the purpose of the investigation, clear and structured to avoid confusion and bias, and fit to answer the research question and objectives. For this research, self-administered questionnaire was chosen for the survey research of the case study and structured in close-ended format. Details of the conduct for survey investigation were discussed in Section 5.8.2. The semi-structured questionnaire was used for the interview instrument (qualitative method) and it was conducted face-to face. Details of the conduct for survey investigation were discussed in Section 5.8.3.

5.5.6 Stage 6: Analyse the Data of the Investigation

The Stage 4 of research design provides clear indication and guideline for this stage on how to analysis the collected data. As referred to Figure 5.2, the data were analysed with the chosen technique, research question and objectives, conceptual model, literature review and the secondary data. Details of the data analysis and reporting of the findings for quantitative and qualitative method were discussed in Chapter 6 and Chapter 7 respectively.

5.6 CHOICES OF METHODS

Research design involves the strategy to develop the appropriate method for the research so that it would link to the purpose of the investigation. According to Easterby-Smith et al (2008), the philosophical view of the researcher can affect the research design in particular the choice of method use. This section discusses the choices of methods that are possible to be used for this research investigation. That are includes quantitative method, qualitative method and mixed methods.

5.6.1 Quantitative Method

The quantitative method is one of the most common research strategy use in social science (Pole and Lampard, 2002) as it provides measurement of the data for a more precise estimate of the degree of relationship between variables (Bryman and Bell, 2007). The quantitative method can be defined as:

> *"an approach emphasising empirical observation and measurement of variables usually involves statistical analysis" (Bryman and Bell, 2007, p. 28).*

Another definition of the quantitative method is that:

> *"it also involves testing a theory by laying assumptions or hypothesis and the drawing conclusions as to whether the theory is accurate or not" (Longman, 2000, p. 21)*

This reflects the quantitative strategy as predominantly associated with the positivist philosophical view, as mentioned in the previous section. The strategy of inquiry in quantitative methods employs the adoption of: (1) a survey which provides a numerical description of collected data; and (2) experimental research (which seek the impact of investigation could influence an outcome) i.e. casual effect of treatment. The quantitative method involves the measurement of variables from the predetermined data collection instruments and produces the statistical results (Creswell, 2003) that are descriptions, relationship, comparison and predictions (Fink, 1995). Since the quantitative approaches yields numerical form of information, it could possibly manipulate the information in precise, structured and reproducible ways. Easterby-Smith et al (2008) criticised that the quantitative method was concentrated on the reliance of its instrument and procedure that it lack of the connection between the research and the real everyday activities and individual behaviour for example. Thus it limits the in-depth understanding of the behaviour or meaning of the subject being investigated in particular the social science field.

5.6.2 Qualitative Method

The qualitative method is an approach that in contrast to what quantitative methods. It does not consider providing statistical data and interest in the words for data collection and analysis. It has been described by various authors as:

> "*qualitative research seems to promise that we will avoid or downplay statistical techniques and the mechanics of the kinds of quantitative methods used"* (Silverman, 2000, p. 1).
>
> *"qualitative research can be constructed as a strategy that usually emphasizes words rather than quantification in the collection and analysis of data"* (Bryman and Bell, 2007, p. 28).

Both of these definitions reflect the qualitative strategy as associated with the interpretivist philosophical view or often naturalistic inquiry of assumptions that seek understanding the research context (Creswell, 2009). This involves the researcher interpreting the meaning of the collected data expressed by the individual respondents in the research context. The strategy of inquiry to conduct the qualitative approach includes narratives, ethnography, grounded theory and case study to gain understanding and in-depth meaning of the subject research. This often requires unstructured or open-ended primary data collection techniques and builds themes for the analysis process with the researcher playing the role as key instrument (Creswell, 2003 and 2009). This approach uses a variety of empirical data or materials such as interview, life story, observational, history, personal experience and visual text (Denzin and Lincoln, 1994). Limitations in qualitative method were related to difficult to replicate the study due to the structure of the investigation was unstructured; and limited number of sample may affect the generalisation of the research problem (Bryman and Bell, 2007; Creswell, 2009).

5.6.3 Mixed Methods

A mixed method is an approach that uses and combines the application of both quantitative and qualitative methods that can contribute towards the influential insight and meaning of the subject research. This provides the researcher with an overview of the research in positivist and interpretivist contest or constructivist paradigm, complementing each other strengths and compensating for weaknesses, whilst giving more perspectives on the investigated phenomena (Easterby-Smith et al., 2008) at the same time. This involves statistical and text analysis which the interpretation and understanding of the data is not limited to one form. Later the findings from both strategies may be corroborated to maintain the reliability of collected data and enable triangulation. A strategy inquiry for mixed methods provides the researcher with flexibility in selecting the appropriate strategy for collecting and analysing the data. This approach does not consider the researcher in determining which method is dominant but both are equally appropriate for research strategy. Creswell (2009) categorises mixed methods research in three strategies of collected data, which are (1) sequential procedure, (2) concurrent procedures and (3) transformative procedures. Table 5.1 outline the alternative strategies of inquiry.

Quantitative	**Qualitative**	**Mixed methods**
▪ Experimental design ▪ Non-experimental design, such as surveys	▪ Narrative research ▪ Phenomenology ▪ Ethnographies ▪ Grounded theory studies ▪ Case study	▪ Sequential ▪ Concurrent ▪ Transformative

Table 5.1 Alternative strategies of inquiry (Source: Creswell, 2009, p.12)

5.7 JUSTIFICATION OF SELECTED METHOD

The previous section has provided valuable input for the researcher in deciding the most appropriate approach to conduct this research. Therefore, this section is designed to further clarify the chosen approach based on: (1) the context of this research; (2) the research questions drawn; (3) the philosophical framework; and (3) the strategy of inquiry. The mixed method approach was chosen as it can be said to be the most appropriate option to carry-out the investigation of this research.

Firstly, the adoption of mixed methods for this research is related to the focus of this research which is to investigate and further understand the effectiveness and role of actors, collaboration and social interaction in supporting the development of cluster for increasing competitiveness and innovation. The purpose of this research has led to the design of three research questions that seek answers and also lead towards the chosen mixed method as the appropriate method. The philosophical framework of this research (see Section 5.3), which is pragmatic i.e. positivism and interpretivism also leads to the adoption of a mixed methods approach as the quantitative method focuses on determining the factors that could support the cluster development with the causal impact of the collaboration and role of actors in cluster building. Meanwhile, the qualitative method is seeks further understanding, explanation and interpretation of the causal impact of the cluster's determinants, collaboration and role of actors in cluster building. Creswell (2009) views that pragmatism researcher does not belong to one worldview and reality, but in pluralistic views that occur in different actions, situations or consequences of event. The use of more than one research method i.e. pluralist methods can give more accurate inferences (Johnson and Turner, 2003) as one method gives statistical breadth findings and the other one gives in-depth understanding of the research findings in context. This applies to mixed methods research in pragmatic paradigm which is used in this research.

Secondly, the mixed methods approach is flexible where the researcher has the freedom to adopt the suitable approaches, techniques and procedures that fit to answer the research questions, particularly the complex issues. Creswell (2009) explained that the increased reputation of the adoption of the mixed methods strategy is because the research method has evolved to enhance the strength both of quantitative and qualitative research and reinforces the complexity of the addressed problem in the social and/or human sciences researches. As the literature discussed in Chapter 2, the cluster studies was mainly based on the experiences of Western and developed countries, while the data mostly collected in quantitative method is related to econometrics techniques. The qualitative method is used in cluster studies mostly to aid in understanding the social interaction and/or relationship in the cluster. However, this research is not limiting nor is it reliant on one approach alone but is also adopting and combining both quantitative and qualitative method in order for the data collection and analysis to answer the research questions (Johnson et al., 2007). For example, the survey in quantitative method is designed structurally so that the impact of cluster determinants represents the population in general, and the statistical finding build up strength and give precise explanations in numbers. Meanwhile the interview in qualitative method is designed semi-structurally so that interview respondents are able to freely express their years of experiences or thoughts (Denzin and Lincoln, 2000) as to the collaborative relationship in the cluster without any constraints or options, and the interview findings deepen the meaning and explanation in words that can connect, integrate or embed the quantitative findings (Kelle, 2006) or vice-versa. Furthermore, with mixed methods research provide the explanation of *"why we do them"* as explained by Tashakkori and Teddlie

(2003) that lead to assist the researcher to answer the research questions addressed for the research project.

Finally, the mixed methods approach serves as mutual validation and coherence of findings that the single method cannot afford to do so via the triangulation approach (Kelle, 2006; Torrace, 2012). Triangulation is defined as:

> *"the combination of methodologies in the study of the same phenomenon".* (Denzin 1978, p: 291)

This allows the results produced to be trustworthy and the triangulation could lower the boundaries between quantitative and qualitative method. This combination of methods, mixed method, are used to enable the corroboration of the other method, develop techniques that can provide deeper insightful data and initiate new ways of inquiry from the combination of both quantitative and qualitative data (Rossman and Wilson, 1985). In this research context, the quantitative data enables the researcher to validate the qualitative data, develop strategies or method to gain wider and trusted data, complementing the result from methods, expanding the meaning of data from one method to the other and vice-versa. Furthermore, the pragmatic research strategies for this investigation are considering the use of several data collections and the research design involves the application of case study, grounded theory and longitudinal studies. Hence this research will employ the mixed methods approaches as the benefits are pragmatic, flexible of methods, inquiry and analysis; and suitable approaches to corroborate the findings through triangulation. All of these benefits fit to answer the research questions addressed for this research.

5.8 METHODS OF DATA COLLECTION

This section discusses the methods of data collection for this research derived from the chosen approach, mixed methods. This includes the sample selection, instruments or techniques used to collect and analyse the data, and the quality issues of the outcomes.

5.8.1 Research Sample

Before the required data or information is collected, it is important to identify a suitable sample for the research that has the desired characteristic for the objectives. The research sample is important as they can provide trustworthiness of data or evidence needed to answer the research questions. The research sample will be able to help the researcher to generally understand characteristics of the population, since it is impossible to collect evidence from the whole population (Easterby-Smith et al., 2008; Saunders et al., 2009) in terms of time, cost and human resources (Forza, 2002). The first step is to identify the target population, and then a sample for this research. Creswell (2009) defined population as:

> *"the whole set of entities that the decision relates to" while the sample is defined as "a subset of those entities from which evidence is gathered"*

To get a representative sample of the target population, each method has its own criteria and sample type that fit to provide credible and trustworthy evidence to answer the research questions. In achieving a clear and credible sample, the combination of sample frame and sample size are relevant for the investigation (Creswell, 2009) and varies in style of sampling depending on the method used, but both qualitative and quantitative methods are subject to either probability sampling (also known as random sampling) design or non-probability sampling design (Neuman, 2006; Easterby-Smith et al., 2008). The sampling frame was drawn from a list of the individuals who were eligible and subsequently available (i.e. respondents) to be included in this research context (Creswell, 2009; Fowler, 2009).

As the setting for this research was in Malaysia, the population of this research are the stakeholders in the MSC Malaysia that represent various categories of actors in the triple helix system. This means that individuals from university, industry and government including the intermediaries that work for the central government who have connections with the MSC are considered the population for this research. Since the chosen approach is mixed methods, each of the methods has a different sample frame. The quantitative method used in this research is to identify the impact of determinants in the development of the cluster and impact of collaboration including the motives, barriers and value of the collaborator's partner in the cluster from the perspective of technology firms. So, for the purpose of the quantitative approach, the sample frame has been identified to represents the population of technology firms in the MSC cluster. As explained in Chapter 2, the technology firms in this research are firms involved in the ICT and the Biotechnology industry.

The samples of firms involved in technology industries (ICT and Biotechnology industry) located within the MSC cluster was taken from three sources which are Small Medium Enterprise Corporation of Malaysia (SME Corp.); Multimedia Development Corporation Sdn. Bhd. (MDeC); and Biotechnology Corporation Sdn. Bhd. (Bio Corp.). These three corporations are intermediaries, which are funded by the central government to support and facilitate the development of local and international firms. There were approximately 500 firms identified that closely matched the desired firm characteristics; operating in ICT and Biotechnology industry, and physically located in the targeted areas of this research, MSC. However the researcher found that only 307 firms are still in business when the survey was undertaken from February to April 2011 and therefore formed the sample used in the research. A questionnaire was created and published online at SurveyMonkey's website (a web-based survey solution provider). Later the web link of the questionnaire was attached together with the email distributed to each targeted sample requesting for cooperative participation. In order to increase the number of participants, increase the level of confidence of the targeted sample and avoid the perception of junk mail, the researcher co-operated with MDeC and Bio Corp. to send emails on behalf of the researcher. From the 307 of firms contacted and sent the on-line questionnaire, completed questionnaires were received from 88, a response rate of 41.9%. The remaining were incomplete questionnaires and unreachable due to email address problems, undelivered emails, the contact person no longer working with the firms, and choosing not to participate in this research. All the eighty eight respondents (58 of ICT firms and 30 of biotechnology firms) who constituted the sample ranged from officer (23.9%) to owner (20.5%), senior management (23.9%), manager (25.0%) and researcher (6.8%) of the firms. Although the proportion of the sample from biotechnology firms is small, their responses are account for one-third (34%) of the total responses. This is a satisfactory percentage of response considering the ICT firms are larger than Biotech firms in the Malaysian technology industry. Details of the respondents' background are presented in Section 6.3.

For the qualitative method, this research has employed a purposive sampling technique to select the appropriate individuals that fit in giving information needed to answer the research questions particularly in this case study research (Saunders et al., 2009). There are 21 individuals that represent key triple helix actors that were chosen to be interviewed. These individuals or samples were carefully selected for the qualitative method to seek further explanation and understanding on the condition of determinants and value of collaboration in cluster, the nature role of these samples plays as triple helix actors in the context of MSC and their thoughts on the engineered cluster of MSC in comparison with other successful clusters. This approach is also useful for the researcher to expand the meaning and corroborate the quantitative data findings for a valid and credible data of this research. Details of the respondents' background are presented in Section 7.2.

5.8.2 Survey Instrument

For the quantitative data collection, a survey was used to produce statistics or numerical descriptions of the study population by asking questions of the sample i.e. questionnaire (Fowler, 2009). The survey also does not have control over the behavioural actions but focuses on current or contemporary events of the research studies as claimed by Yin (1994). It also serves the purpose of minimising and measuring errors in the collected data (Fowler, 2009) and reduces as much bias as possible from the research process (May, 2001). A questionnaire is among popular instruments used in business and management survey. For this research, a self-administered questionnaire was used and administered electronically using the web-based survey solution provider as explained in Section 5.5.1. The reasons for using internet-mediated questionnaires was because of its major strengths in flexibility, low administration cost, speed and timeliness, convenience, controlled sampling, control of answer order and because it minimises errors in the collected data (Evan and Mathur, 2005; Bryman and Bell, 2007; Fowler, 2009).

The questionnaire was structured in a close-ended format, in which the respondent is directed to answer the question from a select list provided (Pole and Lampard, 2002). This will allow the researcher to ask questions that lead to the answers for the research questions. A good survey question's principles i.e. relevance, reliable and valid (Zikmund, 2000) were employed to avoid confusion for the respondents to answer the questions while focusing questions that were relevant to the research. The questionnaire was designed into four separate sections (Appendix 3). The first section is related to the demographic profile of respondents, and consists of ten questions including job position, business industry category, location, status ownership and organisation's years of existence. The second section is related to factors contributing to support firm formation which include determinants of cluster (13 questions), condition of local factors (15 questions), condition of local supplier and customer (4 questions) and value of partner for collaboration in cluster (10 questions). In total there are forty two questions. The third section is related to the relationship and social interaction between university, industry and government through collaboration. There are three sub-sections for this third section which are (1) motives or objective of collaboration (17 questions), (2) barriers or problems of collaboration (17 questions) and (3) potential elements to enhance collaboration in future (11 questions). Both section two and section three are associated with the variables used in the conceptual model as illustrated in Figure 3.11. The questions in these two sections are important to answer the research questions particularly the first and second research question (Section 5.2). The last section, section four, is a comment or feedback section for respondents in relation to the role of collaboration in supporting firm formation. This is an optional question purposely asked to get information that is not covered by the questionnaire. The questionnaire took between 10 to 15 minutes to complete.

The questionnaire used a five-point Likert scale to measure and assesses each item or statement asked ranging from "not important", "less important", "medium important", "important" and "very important". Bryman and Bell (2007) claimed that Likert scale format is considered as one of the most popular format used to measure attitudes in questionnaire design range from very positive to very negative . This enables the respondents to express the intensity of their feeling or attitudes relating to the question asked (Zikmund, 2000). The Likert scales were coded with numbers so that it is easier for the researcher to file and analyse the data with the statistical analysis technique. For example “not important” = scale 1, “less important” = 2, “medium important” = 3, “important” = 4 and “very important” = 5. Furthermore, the questionnaire was designed in English language even though it’s not the mother tongue for Malaysian. The reason for this is because English as a second language is spoken in Malaysia, and generally the research population are able to speak and understand English language. This minimises errors in translating from Malay to the English language, saved costs from translation, saved time for analysis and control the quality of data collection.

5.8.3 Interview Instrument

Another primary data collection used in this research is the interview instrument, for qualitative method. This in-depth interview instrument was used to produce descriptive data that the researcher will be able to use to develop further understanding and social explanation from the selective or purposive sample. Hence it will generate in generalising the meaning of the findings of the research population. A face-to-face interview was used with the participants and this helps the researcher to engage directly, with more open and honest communication (Quinlan, 2011) and gives freedom to control the situation (Manson, 2002). Furthermore, this instrument enables the researcher to increase the number of participants and minimise the incomplete questionnaires which can influence the quality, reliability and valid information or data that is needed to answer the research questions. The researcher is aware that the interview instrument requires skills in communication and building up rapport with the respondents, so that the respondents feels confident and trust (Easterby-Smith et al., 2008) that the sessions are confidential and for the purpose of contributing towards knowledge, filling up the gap in the literature of the context studies and solving the research questions addressed. The researcher also built up early rapport with the respondents prior the interview session to understand more about the respondents themselves, their roles in the organisation, avoiding bias and reducing any awkward atmosphere or situation while maintaining a friendly conversation (Ticehurst and Veal, 2000) during the actual interview process. This is also because the respondents in this research are elite, professional and mature people.

The semi-structured questionnaire was prepared based on the research questions, literatures, conceptual model, reports and quantitative data as displayed to guide and assist the researcher during the session. This is to avoid asking irrelevant questions, maintain the quality and reliability of the information gathered, managing the time schedule and to be flexible with the order of the questions (Saunders et al., 2009). The interview questionnaire is also designed to further interpret and gain greater breadth in understanding of the quantitative findings. The key principles of a good question are also applied in designing the semi-structured interview questions as it was employed for the survey questionnaire in the quantitative method for the same reasons. The interview questionnaire (Appendix 5) was designed with three sections that have very similar section with the survey questionnaire except it more precise and condensed to avoid repetitive questions and to increase the smooth flow of the topic and questions during the interview process. The first section is general background of respondents in relation to experience working in the organisation and the responsibilities as in brief, which consist of two questions. The second section is related to the condition of the MSC including the contribution as a whole, major contributor for the development and the differences with other clusters in developed nations. This comprises of six questions. Finally, the third section is related to the cluster determinants and relationship between university, industry and government, which consist of ten questions. In total there are eighteen questions designed for the interview survey.

As mentioned earlier on in Section 5.8.1, 21 respondents participated in the interview process and the respondents represent the actors in triple helix culture which are university, industry and government. Amongst these participants, there were four respondents from four different universities, six respondents from six different technology firms, two respondents from two different local financial institutions, five respondents from two different corporations acting as intermediaries, and finally four respondents from two different government ministries. Details of the background of the interview respondents are displayed in Table 7.1 (Section 7.2). The interview sessions took approximately between 45 to 120 minutes to complete and recorded. At the start of the interview session, each interview respondents was given a brief as to the nature of this research including the aims, objectives and scope of the research context, why they are selected, what information needed to be included and contributed, approximate time of the interview (Saunders et al., 2009) and permission or consent to audiotape the interview . Also, the interview respondents were assured data confidentiality (Creswell, 2009), recognition not to respond or withdraw to answer the question(s) and taking a break or pause during the session (Saunders et al., 2009). The interview process was conducted in English language including the interview questionnaire due to the same reasons as for the survey instrument (Section 5.5.2). However, the respondents are allowed to use both languages i.e. English and Malays during the interview process to assure their understanding of the questions asked, avoid irrelevant data collection and ensure the respondents feel confident and promote flexibility. The majority of the respondents used English language with little use of the Malay language. The voice recorded data was translated to English language and the researcher has used four independent translators to assist the translation process to assure the translated data were of the same quality and meaning of the original version. These independent translators are two Malaysian mature research students and two Malaysians working as lecturers in UK universities that are all fluent in both languages and have background in business and management as well as conducting qualitative research.

5.8.4 Quality Measure of Research Method

There are several considerations in making sure the research method produces a sound and rigorous research design that is unique compare to other research in related areas and lead to answering the research questions of the research. This section will discuss these issues by employing certain quality measure including pilot testing, sampling, validity and reliability of collected data and the ethical consideration.

- **Pilot testing**

Prior to collecting the primary data, the questionnaire for both quantitative and qualitative data was pilot tested. This helps the researcher to test the credibility of the questionnaire in relation to finding answers for the research questions, control the quality of the questionnaire for the ease of respondents to answer the questions and test that the chosen research design is ready to be used for the real event. Saunders et al. (2009, pp. 394) described the purpose of pilot testing as:

> *"to refine the questionnaire so that the respondents will have no problems in answering the questions and there will be no problem in recording the data".*

Quinlan (2011) added that the pilot test or pilot study is conducted in order to support the improvement of the rigorousness and validity of the research design by testing it in the real life situation with a small number of respondents prior to the actual investigation taking place. It is also worth remembering that the pilot test is not used for the statistical or numerical analysis instead it is used to measure the effectiveness of the questionnaire. As such the results from the test are not included in the research findings. However, the responses received from the pilot test respondents were used to redefine the questionnaire and the data collection techniques.

For the quantitative data collection, structured on-line survey questionnaire, there are ten pilot respondents involves which have background in conducting research and technology business industry as experts. It is important that the background of the pilot respondents is similar in characteristics with those respondents who will be included in the actual survey investigation. An email was sent to each of the piloted respondents describing the aims and purpose of the pilot survey together with an on-line link of the designed survey. The response time for the questionnaire was approximately between 15 to 20 minutes. There was no major concern received from the pilot respondents after completing the pilot test. The feedback gathered including some spelling errors, structure of the sentences, the heavy look of questionnaire design layout, some of the rank scale answer button are not functioning and problems opening the on-line survey link. Changes have been made to rectify the concerns arising from the pilot test and a complement email was sent to thank pilot respondents for their support.

A pilot test was also conducted for the semi-structured interview questions. There are three respondents involved. Two have experience in conducting research using interview as an instrument and one pilot interviewee is from industry. The interview pilot test was conducted in a less formal and thorough way as compared to the survey instrument. This is because the focus of this pilot test is to measure the respondents understanding of the questions asked and avoid potential repetitive answers given by the respondents so that an in-depth explanation of the subject areas from the respondents will be achieved. Also, the questionnaire for the pilot interview is straight forward and the researcher has the flexibility to change the sequence of the questions for further explanation or clarification of the given information as sometimes the interviewee tends to give information for the question that the interviewer intended to ask next. Feedback received on rephrasing the sentence of the questions to make it clearer, change the sequence of the questionnaire and to omit one question that has a repetitive answer. Changes have been made accordingly before the fieldwork began and all of the pilot interviewees were given a thank you card for their cooperation in the pilot test. Overall, the session took approximately 30 minutes to complete.

- **Reliability and validity**

The reliability and validity of the questionnaire and data collected are another step in measuring the quality of the research method. Saunders, Lewis and Thornhill (2009) refer to reliability as *"to the extent to which your data collection techniques or analysis procedures will yield consistent findings"*. This means reliability is related to the concept of consistency in measuring the concept or idea when it is repeated in a similar condition. Bryman and Bell (2007) identified three factors that involves whether the measure used is reliable. They are (1) stability of the measure use over time that will give confident result, (2) internal reliability that refer to the indicators or scale use are consistent and (3) inter-observe consistency that refer to the consistent measure of subjective judgement such as observation and translation of data in open-ended questionnaire is consistent by other observers. The reliability is important to measure the valid variables used in the research so that the data collected has significant credibility criteria to answer the research questions addressed for this research.

There are three forms of reliability which are test-retest, alternate-form and internal consistency (Litwin, 1995, pp. 8; de Vaus, 2002, pp. 17). The test-retest reliability approach is administering the same measure with the same respondents at two separate occasions under similar or nearly the same conditions. The alternate-form reliability approach involves using the same respondents and variables but designed in two alternative instruments that are similar but not identical. It means the items differ only in their wording (Litwin, 1995) but maintain the same respondents, variables and attributes. The internal consistency reliability approach involves correlating and measuring the consistency of multiple items or responses combined to form a single scale. The items in internal consistency are measured by calculating the coefficient value or also known as Cronbach's coefficient alpha. The value of alpha will vary between 1 (perfect internal reliability) and 0 (no internal reliability). The value of 0.8 alpha typically denotes an acceptable level of internal reliability (Easterby-Smith et al, 2008; Bryman and Bell, 2007) though others (Hair et al., 2010; Pole and Lampard, 2002; Hinkin et al., 1997) may accept the value slightly lower i.e. 0.7 as acceptable or satisfactory degree of internal reliability. For this research, the researcher has followed the rule of thumb of 0.7 Cronbach's coefficient alpha is the acceptable degree of reliability. The calculation of Cronbach's coefficient alpha can be achieved by using the computed statistical application software and solutions which produce the output automatically. For this research, the internal consistency of Cronbach's alpha test was used for the quantitative method as it was the most common used in business research (Bryman and Bell, 2007, pp.164; Litwin, 1995, pp. 21) and is simple to assess (Pole and

Lampard, 2002). The overall Cronbach's alpha value was 0.931 (Table 6.3, Section 6.4) and this shows that the survey questionnaire has a high level of internal reliability.

For the qualitative method, the issue of the reliability of the approach was handled in a different approach compared to the quantitative research. Quinlan (2011) describe reliability *"relates to the dependability of the research, to the degree to which the research can be repeated while obtaining consistent results".* However, it is difficult to achieve the same criteria in qualitative research (Bryman and Bell, 2007) as the social context is impossible to replicate. This also contrasts with the philosophical view of qualitative research which is interpretivist that holds that the perspective of every individual has a unique constructed or interpretation of the social world. Thus, the reliability in qualitative research is focused on establishing the soundness of research design and collected data in a consistent manner. In this research, the researcher keep a research diary documenting the researcher thought, experience, observation, notes, comments, insight or decision made throughout the research process. Also, the researcher used the same interview questionnaires with all of the interviewees to avoid bias and the data collected can be expected to be a generalise representation of the sample population. This is to test the consistency and reliability of the answers collected from the interviewee during the interview session.

Following assessing the reliability of measure items or variables, it is also important to assess its validity on how it fits or how well the measure fits (the questionnaire) with what the researcher sets out to measure in reality (Saunders et al., 2009; Litwin, 1995). This means, the credibility or robustness of the data collection method for the researcher to accomplish the aims and objectives set for this research. The assessment of validity can involve many forms but the researcher has identified that there are four forms that are commonly used; they are (1) face validity relates to cursory review of items, (2) content validity relates to subjective measure among experts on the items accurately reflect what was intended to measure, (3) criterion relates to how well the measure use compare with other instrument and (4) construct validity relates to how meaningful the measure used when in practice (Litwin, 1995; Zikmund, 2000; Pole and Lampard, 2002; Bryman and Bell, 2007). For this research, both questionnaire instruments were assessed by qualified experts that have experience in conducting survey research. Changes been made after the reviewed questionnaire process to produce a sound survey questionnaire for the research. Furthermore, the pilot test also added the contribution in content validity of the questionnaire (Section 5.8.4). The criteria of the respondent i.e. sample frame also contributed to increase the validity of data collection techniques that can yield meaningful information to answer the research questions of this research (Section 5.8.1 for research sample). Nonetheless, the combination of reasonable satisfactory degree of reliability and validity help to establish the good quality measure of research method. Both strengthen the findings of this research are logical, true and credible to be believed and have contributed towards theoretical and/or practical implications at the end.

- **Ethical consideration**

Another quality measure for this research is considering the ethical issues prior and during data collection. Before the process of data collections began, the researcher has asked the research sample upon their cooperation to participate in this research including the use of a voice recorder. The researcher has assured the research sample of their confidentiality and informed them of the consequences if they opt for their identity remain ‘open’ as Creswell (2009) stated that *“some participants may not want to have their identity remain confidential”* but it is important to *“well inform about the risk of non-confidentiality”* including the inclusion of their name, background and remarks made upon questionnaire in the final report. The ethical consideration show the researcher's commitment to professionalism by undertaking research practices that develop rapport and build a good relationship between the researcher and the respondents.

The researcher has applied for permission from the Malaysian authorities prior to conducting the interview primary data in Malaysia. This is to comply with the guideline and procedure of undertaking research in Malaysia based on General Circular No. 3 of 1999 (EPU, web access on July 2011). According to the guideline, any foreign nationals or Malaysians from foreign institutions and/or organisations who intend to conduct research in Malaysia are required to apply for permission prior undertaking their research. In doing this, a research form was submitted to the Economic Planning Unit (EPU) and a letter of consent was received following this from the EPU of the Prime Minister's office to conduct research in Malaysia (Appendix 4). A research pass was received and used when conducting data collection in Malaysia and this acted as a pass to enter government official's building in Putrajaya, particularly. Once the fieldwork has been completed, a brief report was submitted to EPU along with the research pass. A copy of the research thesis will be submitted to EPU once the researcher has completed and pass the viva.

During the data collection, the respondents for both survey and interview were informed of the aims, objectives and outcome of the data collected and has encouraged them to participate but they were not pressured or compelled to participate and complete the process. However, the researcher did inform them that the data collected were used for the benefit of knowledge and academic purposes and were not used for the manner that the respondents will object to (Sekaran, 1992) or coerced (Creswell, 2009). The ethical considerations were not only for the data collection, but also throughout the research process including in the data analysis and interpretation, the research organisations, potential readers and the researcher herself that the research contains fundamental ethical values and practices which can measure the quality of the research as a whole.

5.9 ANALYSIS OF DATA

Once the data have been collected and the data file for each method has been created, it is now necessary to do the analysis to get useful information from the collected data either for the statistical estimation and/or explanation of meaning is understood so that the conclusions can be drawn to answer the research questions. This section discusses the techniques used to analysis the collected data. There are two small sections, which are the quantitative data analysis and the qualitative data analysis.

5.9.1 Analysis of Quantitative Data

There are several methods that can be utilised to analyse quantitative data and Easterby-Smith et al. (2008) suggest that the method of analysis depends on the research focus and the research questions addressed. The research focus of this study is to look on the collaborative relationship of actors in the context of cluster development in Malaysia. The qualitative data is used to answer the research. Many research methods books (Saunders et al., 2009; Easterby-Smith et al., 2008; Bryman and Bell, 2007; Ticehurst and Veal, 2000; Fink, 1995) suggest that there are several considerations to undertake for the quantitative analysis includes the type or level of measurement of variables involved.

There are three level of measurement of variables, they are (1) nominal, (2) ordinal and (3) numerical (interval and ratio). Both nominal and ordinal variables are recognised as categorical data as Saunders et al. (2009, pp. 417) refer to this as *"to data whose values cannot be measured numerically but can be either classified into sets (categories)"* and *"can be further sub-divided into descriptive and ranked"*. Nominal data also known as descriptive data is the categorical data that is impossible or cannot be ranked in order (Bryman and Bell, 2007; Saunders et al., 2009). For example in the survey questionnaire, the respondents were asked if their organisation has received any status recognition from the Malaysian government and their choice of answer is "Yes" or "No" in the questionnaire. Ordinal category refers to variables or data that can be rank order or has the criteria of inherent order among categories such as in ratings of satisfaction level. For example in the survey questionnaire, the respondent were asked to rate the level of local factors condition in MSC and their choice of answers rank from "very satisfied", "satisfied", "medium satisfied", "less satisfied" and "not satisfied". Meanwhile numerical data refer to variables that can be measured by numbers and the differences between numbers can be identified in numerical scale. For example in the survey questionnaire, the respondents were asked on the size of firms according to number of employees working in the organisation and the answers choice are 1-10, 11-50, 51-250 and more than 250 employees. However, Bryman and Bell (2007) explained that numerical variables is the highest level of measurement because it enable the researcher to apply a wide range of techniques of analysis followed by ordinal variables and the lowest is nominal variables.

The majority of questions designed in this survey questionnaire (Appendix 3) have an ordinal level of measurement, so the relative position of data are more precise than the nominal type of category. Based on the focus of this research and the type of variables involved, this research has analysed the survey data with the following statistical analysis techniques.

Univariate descriptive statistics are mainly used to measure and describe the pattern of data in the form of frequency tables, diagrams, mean and percentage distribution (Bryman and Bell, 2007). For this research, the univariate descriptive statistics were used to provide the description of the respondent's background and characteristics. This analysis was also used to address the research questions by looking at mean distributions on factors contributing to cluster development including the condition of local factors, value of partner in collaboration and the influence of collaboration in cluster such as the motive and barriers of collaboration and factors that can enhance collaboration in the future.

Cronbach's coefficient alpha was used to measure the reliability of the variables in the survey questionnaire (Easterby-Smith et al., 2008) as it was explained in Section 5.8.4 for the quality measure of the research strategy. This test measure the reliability of the variables for the factors contributing to support firm formation which include determinants of cluster, relationship and social interaction between university, industry and government through collaboration and the potential elements to enhance collaboration in future as based on the three sections in survey questionnaire (Appendix 3).

Non-parametric statistic was used when the type of data involved was categorical and the data is not normally distributed (Saunders et al., 2009). This test is to measure any significant differences between two groups. The Mann-Whitney *U* test was used for the non-parametric statistical analysis and alternative to the Independent *t*-test (parametric statistic test). For example, in this study, the Mann-Whitney *U* test was performed to identify whether there are any significant differences in important factors of firms formation, impact of local factors, objectives of collaborations and barriers of collaborations between firms from the ICT and Biotech industry in MSC. The following Chapter 6 will present the statistical analysis techniques employed for the quantitative data by using the Predictive Analytics Software (PASW).

5.9.2 Analysis of Qualitative Data

As outlined earlier in Section 1.5 and Section 5.5, the research study uses an in-depth interview as another main primary data collection method and to complete part of the mixed method approach. The qualitative data for this study is important to answer the research questions and corroborate with the quantitative data through the triangulation approach. This in-depth interview instrument requires tools that can transform and analyse large amount of narrative data into meaningful conclusion and credible data in order to answer the research questions. Analysing qualitative data is tedious and requires a systematic approach in segmenting the large data and reassembling into an analytic interpretation that the researcher may not have anticipated during initial conception. This require a systematic and integrative procedure that at the end can produce useful, creative and interesting, meaningful and offer contribution to the body of knowledge. Boeije (2011) claimed that the integration process of qualitative data into a coherent and analytical format was the challenging stage in any qualitative research. The researcher decided that the content analysis was the most appropriate method for analysing the interview data since it involves the large amount of text data that is a flexible method to analyse (Hsieh and Shanon, 2005). The text data derived after the researcher translate and transcribe the audio-recorded interview that the researcher has received permission from the interview respondents to record. There are 21 interview respondents involved for this method and the detailed background of the respondents and described in Section 7.2. The respondents were carefully selected in order to fit with the research focus and context as discuss in Section 5.8.1 of the research sample section.

The content analysis involves the process and use of coding and themes in analysing the text data. In this research, the code and themes emerged from the noticeable pattern of words and phrase that can be related and associated with the research questions, conceptual framework and literature. For this analysis, the computer assisted analysis QSR NVivo 10 was made use to further validate the techniques and to give a systematic coding approach of the text data in order to get a robust analysis strategies and data findings. Further details of the processes of qualitative data analysis were discussed in Section 7.2.

An influence diagram was used to conceptually and logically visualise the series of causal-effect relationship in diagrammatic method of the variables or key themes or data or event that connect or interact with each other. The influence diagram have positive (+) and negative (-) feedback loops indicating the nature relationship between the linked factors. This method is widely used in operation and strategy research to evaluate the problem and bridge the gap between the analysis and formulation (Schater, 1986) in enhancing the business decision making. For this research, the influence diagram was used to conceptually visualise the causal-effect of the key information or themes or variables emerging from the interview data to develop, understand and reach a conclusion for the research.

5.10 RESEARCH STRATEGY TO ANSWER RESEARCH QUESTION AND OBJECTIVES

The research question and objectives of this research has been presented in Section 1.3 and Section 5.2. In line to answer the research question, there are four research objectives were built and it is necessary to design on how to achieve the objectives. Each research objectives requires more than one resources including data from the primary resource (survey and interview data), conceptual model, literature review and secondary data (economic and statistical report of context study i.e. Malaysia and MSC). The previous sections have detailed the research design of the investigation in line to answer the research question and objectives. Based on that, this section provides an overview on how the research method has assisted to meet output for each of the research objectives of this research. The framework of the strategy was illustrated in Figure 5.2. Outline for strategy of inquiry of achieving research objectives:

1. Research Objective 1 (RO1)

   Explore and investigate the factors (determinants) for the development of firm in a cluster.

Strategy 1.1	: Identify the factors of firm development in successful clusters i.e. Silicon Valley, US and Cambridge, UK.
Output 1.1	: Literature review (Section 2.2.4 and Section 2.2.5)
Strategy 1.2	: Identify the factors of firm development in the case study i.e. MSC cluster of Malaysia.
Output 1.2	: Survey output (Section 6.5.1, Section 6.5.2 and Section 6.6); interview output (Section 7.3, Section 7.4 and Section 7.5);

conceptual model (Section 3.3); secondary data (Section 4.2, Section 4.3, Section 4.4, Section 4.5 and Section 4.6)

2. Research Objective 2 (RO2)

   Examine the factors that influence firm growth in the cluster: the collaboration effect including motives and barriers.

   Strategy 2.1 : Identify and examine the motivation impact of collaboration in MSC.

   Output 2.1 : Survey output (Section 6.5.2); interview output (Section 7.5.1 and Section 7.6); conceptual model (Section 3.3)

   Strategy 2.2 : Identify and examine the barriers impact of collaboration in MSC.

   Output 2.2 : Survey output (Section 6.5.2); interview output (Section 7.5.2 and Section 7.6); conceptual model (Section 3.3)

3. Research Objective 3 (RO3)

   Understand the nature and role of university, industry and government; and its relationship in cluster development (MSC Cluster).

   Strategy 3.1 : Identify and examine the role of university, industry and government; and its relationship in innovative cluster.

   Output 3.1 : Literature review (Section 2.2.7)

   Strategy 3.2 : Identify and examine the role of university, industry and government; and its relationship in the case study (MSC).

Output 3.2 : Survey output (Section 6.5.1.4, Section 6.5.1.5, and Section 6.5.1.6); interview output (Section 7.4 and Section 7.6); conceptual model (Section 3.3)

4. Research Objective 4 (RO4)

Identify the primary determinant condition factors that make the MSC cluster different from organically formed clusters.

Strategy 4.1 : Identify the differences of factors between Strategy 1.1 and Strategy 1.2.

Output 4.1 : Literature review (Section 2.2.4 and Section 2.2.5), Survey output (Section 6.5.1, Section 6.5.2 and Section 6.6); interview output (Section 7.3, Section 7.4, Section 7.5 and Section 7.6); conceptual model (Section 3.3); secondary data (Section 4.2, Section 4.3, Section 4.4, Section 4.5 and Section 4.6)

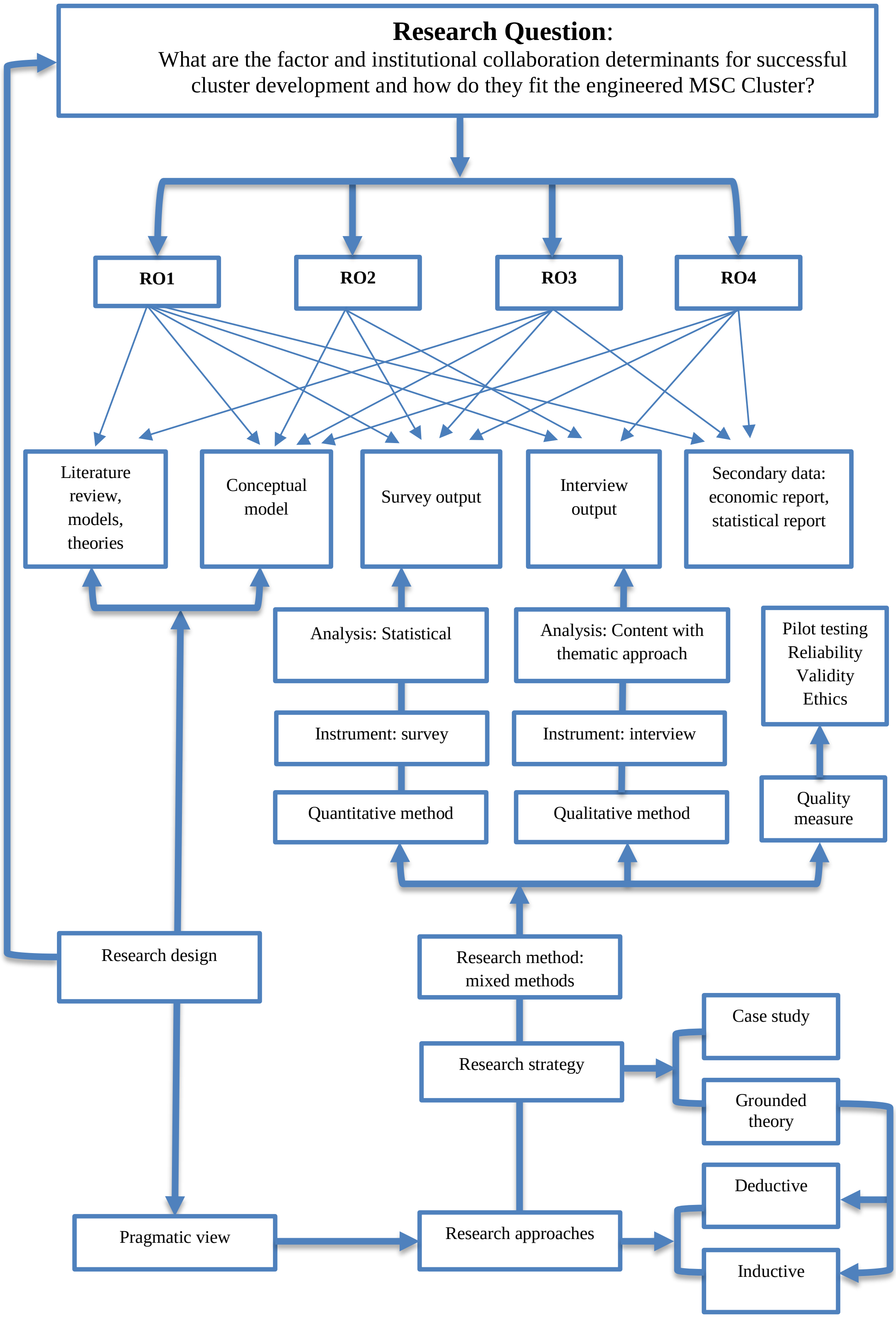


Figure 5.3: Research strategy to answer research question and objectives of the study

(Source: author)

5.11 CONCLUSION

Throughout, this Chapter 5 has discussed the methodology and data analysis used in this research study which enables the researcher to answer the addressed research questions. Each stage of the research study were presented and illustrated in Figure 5.1 to indicate the stages of undertaken research. A detailed discussion of research design framework was presented and involved six different stages from designing research questions and objectives, conceptual model, research strategies to detailed analysis of the data of the investigation (Figure 5.2).

The strategy of inquiry discussed the available research strategy that can be made use of for this study including the qualitative, quantitative and mixed methods approach. The chosen method, mixed methods was made based on the researcher's philosophical understanding i.e. pragmatic approach of the research along with the research focus, research questions, conceptual context and extensive literature reviews on cluster development and collaborative relationship. The appropriateness and suitability of the method for data collection and analysis were also discussed. The method of data collection includes the sample selection (sample size – technology firms in ICT and Biotechnology industries, universities, government agencies including intermediaries located within and near MSC with experience in collaborative arrangements with each other), instruments (on-line survey and face-to-face interview) and quality issues (pilot testing, sampling, validity and reliability of data collected and ethical consideration) of the outcomes for both quantitative and qualitative method.

The analyses of quantitative data collection were measured by using statistical analysis includes Univariate descriptive (measure and describe pattern of data), Cronbach's coefficient alpha (measure reliability of variables from survey), and Non-parametric of

Mann-Whitney U test (measure any significant differences between two groups i.e. ICT and Biotech industries). For qualitative data analysis, content analysis was chosen and used since it involved large amount of text data of 21 interview respondents. The process involves coding and thematic analyses that were based on the key determinants of cluster development recognised in innovation and cluster literature (Chapter 2 and 3) and the conceptual model (Figure 3.11). A computer assisted analysis (QSR NVivo 10) was used to further validate the techniques and provide a systematic coding approach. The influence diagram approach was used to conceptually and logically visualise the series of casual-effect relationship (positive and negative feedback loops) of key themes (variables) emerging from the text data. This was to assist the analysis process and further to understand the output and reach a conclusion for the research subject.

As an overall overview of methodology chapter, a strategy framework (Figure 5.3) was designed and presented to conclude the assistance of research method to meet the output of each research objectives and leading to answer the research question of this research. Using this research strategy to answer the research question also provided support to validate the appropriateness of research method designed and mapping the link between the research objectives, methods used, implemented strategies and approaches, philosophical view and research design.

CHAPTER 6

QUANTITATIVE DATA ANALYSIS

6.1 INTRODUCTION

This chapter present the quantitative data collected by using the survey instrument. The chapter begin with the distribution of sample and background of the respondents. The reliability of the variables in the questionnaire also present in this chapter. As Chapter 5 discussed, the data is analysed using univariate descriptive analysis and Mann-Whitney U tests. The conclusion of the quantitative data is illustrated in the form of influence diagram to capture the whole picture of the findings to enhance the understanding and meaning of the analyses to this research.

6.2 DISTRIBUTION OF SAMPLE

The sample for the survey has been indicated in Section 5.8.1. It consists of firms from ICT and Biotech industries. The survey was a self-administered questionnaire and distributed on-line through a web-link at https://www.surveymonkey.com/s/BVKZCF7 so the respondents be able to participate and complete in a flexible time. Email participation (Appendix 3) was achieved by sending the questionnaire along with a support letter from the principal supervisor.

In total there were 307 firms contacted of which 97 firms were unreachable and thus invalid. This was due to email address problems, undelivered emails and target contact had left the firms or details invalid. There were 88 valid responses received and therefore the total response rate for survey is 41.9%. The calculation of response rate is based on a formula suggested by Saunders et al. (2009) and Neumann (2005) as follows:

Response rate calculation formula:

$$\text{Total Response Rate} = \frac{\text{Total number of response}}{\text{Total number in sample} - (\text{ineligible} + \text{unreachable})}$$

Response rate calculation:

$$\text{Total Response Rate} = \frac{88}{307 - 97} = 41.9\%$$

The completed and valid responses were collected from nine of categories of technology firms. There are six categories of ICT industry and three categories of Biotech industry. The distribution of sample response by industry category is shown in Table 6.1.

Nature of Business	**Industry**	**Frequency**	**Percentage (%)**
Creative Multimedia	ICT	7	8.0
Support Services	ICT	20	22.7
Internet Based Business	ICT	7	8.0
Software Development	ICT	14	15.9
Hardware Design	ICT	3	3.4
Shared Services & Outsourcing	ICT	7	8.0
Agriculture Biotechnology	Biotech	12	13.6
Healthcare Biotechnology	Biotech	10	11.4
Industrial Biotechnology	Biotech	8	9.1
Total		**88**	**100.0**

Table 6.1: Distribution of sample by industry category

6.3 BACKGROUND OF SAMPLE

The focus of this element of the research is to target respondents who are in a position to make decisions for their firms. 69.4% of respondents come from a manager and owner status. The majority of these respondents are manager (25.0%), followed by senior management (23.9%), officer (23.9%), owner (20.5%) and researcher (6.8%). There were more respondents from ICT industry (65.9%) compared to biotechnology industry (34.1%). This was not a surprise since the biotechnology industry is considered quite young for Malaysia since it was publicly launched by the federal government in 2005. Respondents from other industries such as logistic and banking services were received but these were not used as the focus for this study is on firms in ICT and Biotech industries. In total there were 88 technology firms from the ICT and Biotech industry considered.

It was found that 62.5% of respondents were in local firms with private ownership. The second largest group consisted of firms owned by both local and foreign private firm partnership (11.1% of respondents) followed by wholly local firms with public ownership (9.1% of respondents) and foreign firms with private ownership (8.0% of respondents). Thus, it can be considered total local firms contributed 74.8% to this research element.

As for the recognition status, 43.2% of respondents do not have any recognition. Recognition in this instance constitutes firms that have obtained some form of recognition such as being a Bionexus Partner or Multimedia Super Corridor (MSC) status company. Both Bionexus Partners and MSC status companies' constitute 27.3% and 23.9% respectively of those companies surveyed. This information will give an indication on the support and incentives received by technology firms in order to support their business development and progress. There were only 5.7% of respondents from companies who have other recognition not listed in the survey. As overall, majority (56.8%) of the respondents received support from the federal government.

With regards to the size of firms, the survey found that 36.4% of respondents came from small firm (1-10 employees) with a further 29.5% from firms with more than 250 employees, 27.3% were from firms that have employees between 11-50 people, while the remaining 6.8% of respondents were from firms with 50 – 250 employees. This result suggested that there was a fair distribution of size of firms represented in the sample and the majority of firms are small and medium sized with less than 50 employees, which contributed 63.7% of total respondents. The summary distribution of the sample is displayed in Table 6.2.

Characteristic	Category	Frequency	Percentage (%)
Employment status	Officer	21	23.9
	Researcher	6	6.8
	Manager	22	25.0
	Senior management	21	23.9
	Owner	18	20.5
Industry	ICT	58	65.9
	Biotechnology	30	34.1
Ownership status	Local private	55	62.5
	Local public	8	9.1
	Local private & public	6	6.8
	Foreign private	7	8.0
	Foreign public	1	1.1
	Local & foreign private	10	11.4
	Local & foreign public	1	1.1
Recognition status	Multimedia Super Corridor (MSC)	21	23.9
	Bionexus Partner	24	27.3
	None	38	43.2
	Other	5	5.7
Size of firms (employees)	1 – 10	32	36.4
	11 – 50	24	27.3
	51 – 250	6	6.8
	More than 250	26	29.5
Size of firms (years of existence)	Below 5	12	13.6
	5 – 9	35	39.8
	10 – 14	15	17.0
	15 – 19	5	5.7
	20 – 24	5	5.7
	Above 25	16	18.2

Table 6.2: Distribution of sample by demographic characteristic

6.4 RELIABILITY TEST

A reliability test was used on the quantitative data to measure the consistency of the questionnaire. As previously indicated in Section 5.6.4, a computer assisted calculation was used to produce an internal consistency value. For this survey data, the overall score for Cronbach's Alpha internal consistency were 0.931 and therefore acceptable and in the good scale (range from 0.9 > $\alpha \geq$ 0.7). Table 6.3 indicates the overall scores for the whole questionnaire and Appendix 6 shows reliability of each variable.

Variables	Cronbach's Alpha	Number (N) of item
Cluster factor condition	0.785	12
Local factor condition	0.821	18
Value of collaborative partner	0.758	10
Motive of collaboration	0.822	16
Barrier of collaboration	0.889	17
Potential of collaboration	0.786	11
All variables	**0.931**	**84**

Table 6.3: The reliability test analysis

6.5 DESCRIPTIVE ANALYSIS

One of the types of analyses used for quantitative data (Section 5.9.1) was descriptive analysis that describes the data in terms of measuring the mean value or central tendency. This analysis summarises the patterns of data collected from the survey respondents. In this research, the mean score, frequency and percentage distribution of the collected data provides important indication of survey respondent's perception and views on the condition of the cluster's factors or determinants, such as the firm's development of business idea and supporting factors for the firm's business performance; local factor conditions such as infrastructure and social relationship aspects from the perspective of enabling collaboration including the motive and barrier of collaborating in the cluster.

6.5.1 Factor to Support Firms' Formation and Development in Cluster

This section presents the descriptive data analysis for the factors that contribute to the formation and development of firms in the cluster (MSC). They include the source of the business idea, support or incentives received from the government, the important level on factors to support firm development (cluster determinants), the important impact of local factors including the easiness to reach supplier and type of customers or target market, and also the impact on type of partner when collaborating. The information gathered and analysed in this section will contribute to answer the research questions addressed.

6.5.1.1 Source of business idea formation

The development of a cluster starts with the development of firm's business ideas in the cluster itself (the geographic region). It is important therefore to know where the origin of the idea to form new ventures or firms comes from. The result indicates that the majority of respondents (64.8%) developed the idea on their own to form a new venture compared to other sources (see Table 6.3). The ideas were generated while the owner was working in other firms (11.4%) and in some instances while working within other institutions (6.8%) such as a university or research organisation. Collaboration has also generated ideas for the formation of new firms and the results suggests that collaboration with other firms ranked as the third highest with 8.0% while 5.7% constitute collaboration with another institution. The results also found that 3.4% of the ideas came from other sources such as initiatives by the government, political influences, innovation led and also foreign firms.

At only 13.7% it can be argued that this is secondary of respondents indicates that their organisation was develops through the role of collaboration and this has shown that collaboration can be used as a strategic mechanism for the development and progress in cluster.

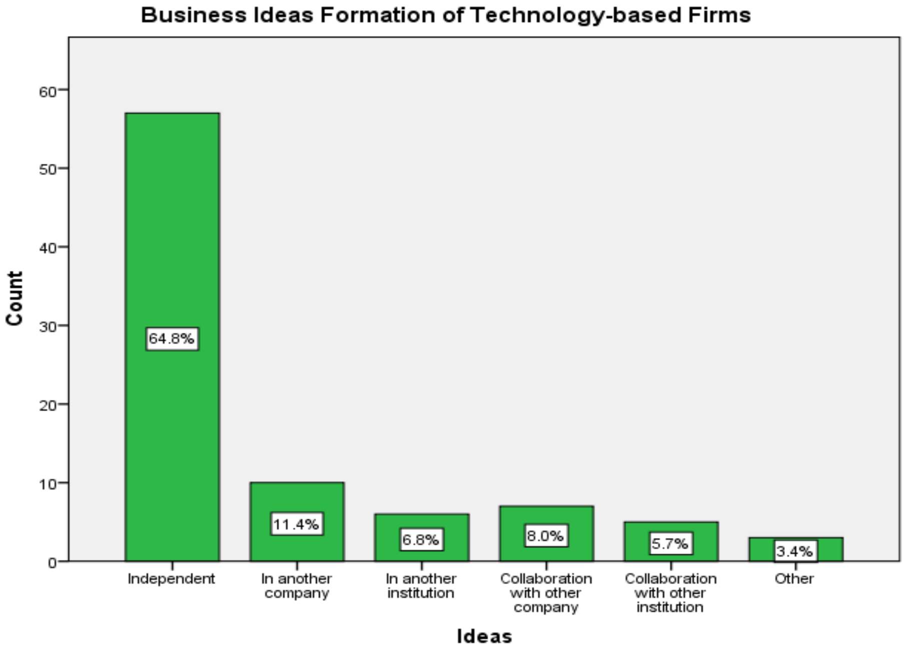


Figure 6.1: Source of business idea formation in the MSC Cluster

6.5.1.2 Recognition as an incentive to support firm

Government roles in giving support such as tax benefits, research grants and awarding incentives can be considered important in the development of firms particularly for new start-up. Respondents were asked to identify any status recognition received for their organisation. There are two types of recognition outlined in the case which are: (1) MSC Status Companies for ICT industry; and (2) Bio-Nexus Status Companies for the biotechnology industry. They are given by the government to support the development of the firms in areas such as commercialisation, research funding and for connection to markets (Appendix 1 and 2). The survey results found that 56.8% of respondents are currently receiving incentives based on the status recognition (Figure 6.2, Table 6.4). Respondents were asked to evaluate the impact of having such status recognition on their organisation; this is outlined in Figure 6.2. The impact was scaled from 1 (no impact) to 5 (very high impact). The majority of respondents who have status recognition valued it as "very high impact" with 44%, followed by 40% of respondents who valued it as "high impact" to their organisation. There were only a small number of respondents (2%) who regarded recognition as "not having any impact" on their firms. Overall, the respondents who have recognition status agreed that by having status recognition it could possibly give a positive impact and benefits to firms. This has indicated that the support from government in terms of status recognition is an incentive for firms to progress as 84% of the respondents regard this as high impact.

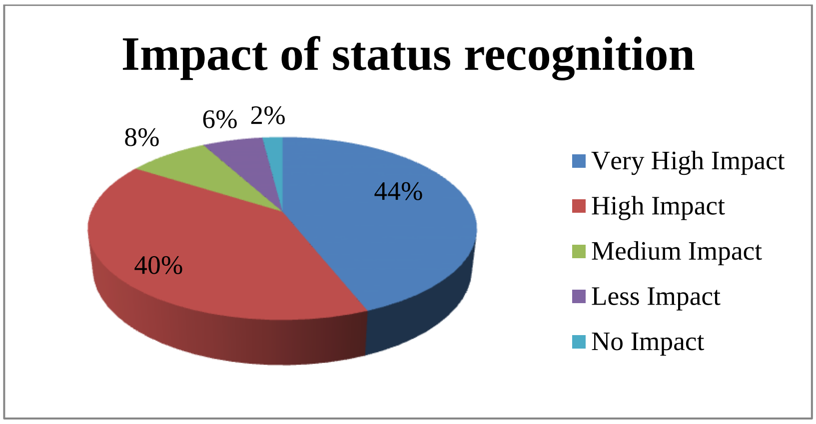


Figure 6.2: Overall impact of status recognition to firms in the MSC Cluster

Impact of status recognition	ICT		Biotech	
	Frequency	%	Frequency	%
No Impact	1	1.7	-	-
Less Impact	1	1.7	2	6.7
Medium Impact	2	3.4	2	6.7
High Impact	10	17.2	10	33.3
Very High Impact	13	22.4	9	30.0
Not Applicable	31	53.4	7	23.3
Total	**58**	**100.0**	**30**	**100.0**

Table 6.4: Impact of status recognition to firms by industry

6.5.1.3 Impact of research and development (R&D) to firms

Technology based firm generally perceived research and development as an important business activity to their firm. Respondents in this survey were asked to rank how significant the impact of research and development was to the activities of their firm on a scale of 1 (no impact) to 5 (very high impact). Based on descriptive statistic displayed in Table 6.5, a majority of respondents agreed that R&D give a significant impact to their firms where 46.6% regards as “very high impact”, 37.5% as “high impact” and 6.8% as “medium impact”. There were only 9.1% of respondent who perceived R&D giving “less impact” to their firm. What is interesting from this data is that, almost all of the respondents agreed that being actively involved in R&D activities could possibly have an impact to their firms. This indicates that technology firms perceive R&D as important to the progress of their firms.

Impact of R&D	Overall Frequency	Overall %	ICT (%)	Biotech (%)
Less Impact	8	9.1	8 (13.8)	0 (0.0)
Medium Impact	6	6.8	4 (6.9)	2 (6.7)
High Impact	33	37.5	25 (43.1)	8 (26.7)
Very High Impact	41	46.6	21 (36.2)	20 (66.7)
Total	**88**	**100.0**	**58 (100.0)**	**30 (100.0)**

Table 6.5: Impact of R&D to firms

6.5.1.4 Determinants of cluster development

This section is designed to identify and explore the current situation of determinants related to cluster development in the MSC. It is important to identify only those determinants which register as important criteria i.e. mean score of four and above. Respondents were asked to identify the impact of a list of determinants in the questionnaire using a five-point Likert scale ranging from “not important” (scale 1) to “very high important” (scale 5). Of the 12 key determinants evaluated, it was revealed that 5 were most important based on the highest score of the mean (Table 6.6). The results revealed that a majority of respondents (93.1%) indicated the role of government in its policy and support as the most important factor to support firms in the MSC cluster with a high mean score of 4.34. Other most important factors identified include the capability of firms in connecting to their current market, availability of current technology including its facilities and equipment, healthy relationship with industry and also with government agencies. For these four factors the mean scores were 4.22, 4.15, 4.02 and 4.00 respectively.

The mean score result also indicated that a majority of respondents perceived funding as of “medium important” to support firms. This funding support includes investment allocation for R&D activities and the availability of local financial support, with mean score of 3.85 and 3.80 respectively. Other “medium important” factors identified for firm’s support included issues on patent and intellectual property (mean score of 3.73), capability of local business with quality and skills (mean score of 3.67), culture issues including trust (mean score of 3.65) and geographical location of firms (mean score of 3.43).

Interestingly, the elements of social issues which is having relationships with local higher education (i.e. university) is considered as least important to respondents and it also has the lowest mean score of 3.08. This result shows respondents are not interested in having social interactions with the university as they perceived such a relationship will not yield any benefits to them. The respondents' cumulative percentage score of "importance" and "above" was below the average of 37.5%.

Important factors to support firm formation	**Overall Cumulative % (Importance and above)**	**Overall Mean (SD)**	**ICT (SD)**	**Biotech (SD)**
Government policy, support & regulations	93.1	4.34 (0.64)	4.29 (0.62)	4.43 (0.68)
Connection to market	71.8	4.22 (0.90)	4.09 (0.88)	4.47 (0.90)
Availability of technology	79.5	4.15 (0.82)	4.10 (0.89)	4.23 (0.68)
Close relationship with industry	76.2	4.02 (0.83)	4.07 (0.77)	3.93 (0.94)
Close relationship with government's agencies	78.4	4.00 (0.84)	4.02 (0.80)	3.97 (0.93)
Involvement and allocation of R&D	65.9	3.85 (1.02)	3.64 (0.91)	4.27 (0.91)
Availability of financial support	74.8	3.80 (0.95)	3.72 (0.85)	3.93 (1.11)
Issues on IP	62.5	3.73 (1.01)	3.57 (0.97)	4.03 (1.03)
Availability and quality of local entrepreneurs and skills	60.2	3.67 (0.88)	3.62 (0.89)	3.77 (0.86)
Culture issues including trust	65.9	3.65 (0.91)	3.67 (0.96)	3.60 (0.81)
Physical location of premises	48.9	3.43 (0.87)	3.33 (0.82)	3.63 (0.93)
Close relationship with university	37.5	3.08 (1.23)	2.93 (1.25)	3.37 (1.16)
Total		**45.94 (10.02)**	**45.05 (10.61)**	**47.63 (10.94)**

Table 6.6: Mean score distribution for importance factor contributing to support firm formation

6.5.1.5 Impact of local factors conditions in cluster

The condition of local factors in the cluster is one of the aspects highlighted in this research. The data indicate the satisfaction level of local facilities and support in the geographical area of respondents (Table 6.7). There were 14 items asked on the condition of local factors support within the location of the respondents. Respondents were also asked to scale their impact based on their opinion, using a five-point Likert scale ranging from "very satisfied" to "not satisfied". A majority of respondents were satisfied with the quality of local services and infrastructure provided in their area. The highest satisfaction factor, with mean score of 4.13 and 80.7% is the communication system such as the internet infrastructure. This result indicates the usage of ICT is important for selective operation of firms. The local factor of cost to employ local skills, was rated with mean score of 3.78; indicating the employment cost are at affordable and acceptable levels to the firms. Other local factors were also rated as "satisfied" by the respondents (Table 6.7).

Local factors	**Overall Cumulative % (Satisfied and above)**	**Overall Mean (SD)**	**ICT (SD)**	**Biotech (SD)**
Communication system e.g. internet connection	80.7	4.13 (0.85)	4.14 (0.83)	4.10 (0.92)
Cost to employ locals in your industry	69.3	3.78 (0.81)	3.78 (0.86)	3.80 (0.71)
Mail and parcel delivery	65.9	3.73 (0.87)	3.72 (0.89)	3.73 (0.83)
Work ethic of related people in your industry	65.9	3.69 (0.90)	3.74 (0.87)	3.60 (0.97)
Quality of local skills in your industry	59.1	3.66 (1.02)	3.59 (1.01)	3.80 (1.03)
Organisation's current geographic location in your industry	55.7	3.60 (0.99)	3.57 (1.01)	3.67 (0.96)
Availability of local amenities	49.0	3.56 (0.93)	3.60 (0.93)	3.47 (0.94)
Quantity of local skills in your industry	53.4	3.55 (0.87)	3.52 (0.88)	3.60 (0.85)
Health care services	45.4	3.44 (0.92)	3.50 (0.90)	3.33 (0.96)
Road and transport system e.g. train, bus and etc.	45.5	3.36 (0.96)	3.34 (0.95)	3.10 (1.00)
Availability to access finance for your industry	39.8	3.13 (1.10)	3.28 (0.91)	2.83 (1.37)
Availability of venture capital to invest in your industry	25.0	2.83 (1.17)	2.91 (1.05)	2.67 (1.34)
Role of local university to facilitate knowledge transfer activities	25.1	2.81 (1.03)	2.76 (1.05)	2.90 (0.99)
Role of local research institution to facilitate knowledge transfer activities	23.9	2.80 (1.02)	2.71 (0.99)	2.97 (1.07)
Total		**48.07 (13.44)**	**48.16 (11.78)**	**47.57 (13.94)**

Table 6.7: Mean score distribution for local factors conditions in cluster

In contrast, a majority of respondents were less satisfied with the financial support for their industry. The mean score for access to finance and availability of local venture capitalist were 3.13 and 2.83 respectively. The cumulative percentage of “satisfied” and “above” was below average with 39.8% and 25.0% respectively. The data also suggested respondents were less satisfied with the knowledge activities provided by the local university and research institution with mean scores of 2.81 and 2.80 respectively. Overall, the majority of respondents are happy and satisfied with the local infrastructure and services provides by the local authority. However, the role of the local university and research institution in facilitating the knowledge transfer activities looks disappointing.

Further, the respondents were asked about the type of customers and suppliers for their business; indicating the type of market that the firms were involved. As shown in Table 6.8, the majority (44.3%) of firms targeted local and overseas markets followed by 42% for local markets. This descriptive result also indicates that technology firms in the MSC use both local and overseas supplier for their business, with the majority combining local and overseas suppliers (54.5%). Local suppliers alone contribute 38.6% and overseas suppliers were 6%. The respondents were also asked about the condition of local support and suppliers to their business performance on a scale of 1 (very difficult) to 5 (very easy). Table 6.9 shows the descriptive statistics for these, and based on these results, support was difficult (25%) and easy (21.6%), with the majority considered as medium (46.6%). The result shows the same pattern on the condition to reach the supplier (Table 6.9).

		Overall Frequency	Overall %	ICT (%)	Biotech (%)
Customer	Local Markets	37	42.0	25 (43.1)	12 (40.0)
	Overseas Markets	12	13.6	6 (10.3)	6 (20.0)
	Local & Overseas	39	44.3	27 (46.6)	12 (40.0)
	Total	**88**	**100.0**	**58 (100.0)**	**30 (100.0)**
Supplier	Local Suppliers	34	38.6	24 (41.4)	10 (33.3)
	Overseas Suppliers	6	6.8	5 (8.6)	1 (3.3)
	Local & Overseas supplier	48	54.5	29 (50.0)	19 (63.3)
	Total	**88**	**100.0**	**58 (100.0)**	**30 (100.0)**

Table 6.8: Type of customer and supplier of respondents

		Overall Frequency	Overall %	ICT (%)	Biotech (%)
Local support condition	Very Difficult	4	4.5	2 (3.4)	2 (6.7)
	Difficult	18	25.0	9 (15.5)	9 (30.0)
	Medium	41	46.6	30 (51.7)	11 (36.7)
	Easy	19	21.6	14 (24.1)	5 (16.7)
	Very Easy	6	6.8	3 (5.2)	3 (10.0)
	Total	**88**	**100.0**	**58 (100.0)**	**30 (100.0)**
	Mean Score	**3.06**	**-**	**3.12**	**2.93**
Supplier contact	Very Difficult	-	-	-	-
	Difficult	4	4.5	3 (5.2)	1 (3.3)
	Medium	43	48.9	29 (50.0)	14 (46.7)
	Easy	37	42.0	26 (44.8)	11 (36.7)
	Very Easy	4	4.5	-	4 (13.3)
	Total	**88**	**100.0**	**58 (100.0)**	**30 (100.0)**
	Mean Score	**3.47**	**-**	**3.40**	**3.60**

Table 6.9: Impact of local support condition and easiness to reach supplier

6.5.1.6 Identifying value of actors in the cluster from the industry perspective

In this section respondents were asked to indicate the impact of various actors in the MSC cluster i.e. partners in collaboration. The respondents were asked to rate the significant value of each partner with respect to the benefits to their organisations by using a five-point Likert scale ranging from “no value” (1) to “very high value” (5). There were nine different types of collaborator’s partner to consider (Table 6.10). The highest mean score was for customer (4.25) as expected, followed by government agencies (3.94), suppliers (3.92) and foreign firms (3.91).

Interestingly the result reveals university as the least valuable for firms to collaborate with; a mean score of 2.90 and only 31.8% of respondents indicate as “high value”. Also, the value of research institutions has the second lowest mean score with 3.05. This data suggest that the role of the university as a collaborator does not significantly contribute to any high valuable benefits for the firms in the cluster with 68.2% of respondents rated as medium value and below. The rest of the actors were valued between a mean score of 3.0 to 3.8 (Table 6.10). This is probably explained by technology firms being less interested to work with the university as a collaborative partner (and also with the local research institutions) than with customers, government agencies, suppliers, foreign firms, financial institution and local firms.

Collaborating Partner	Cumulative % (High Value and above)	Overall Mean (SD)	ICT (SD)	Biotech (SD)
Customers	86.4	4.25 (0.81)	4.22 (0.73)	4.30 (0.95)
Government Agencies	63.9	3.94 (0.90)	3.91 (0.92)	4.00 (0.87)
Suppliers	76.5	3.92 (0.82)	3.83 (0.80)	4.10 (0.84)
Foreign firms	69.3	3.91 (0.81)	4.07 (0.77)	3.60 (0.81)
Financial institution	61.5	3.72 (0.97)	3.72 (0.89)	3.70 (1.12)
Local firms	61.4	3.66 (0.90)	3.69 (0.92)	3.60 (0.85)
Intermediaries	42.3	3.52 (1.00)	3.40 (0.99)	3.77 (1.01)
Research Institution	35.3	3.05 (1.09)	2.95 (1.11)	3.23 (1.04)
University	31.8	2.90 (1.18)	2.78 (1.20)	3.13 (1.14)
Total		**32.87 (8.48)**	**32.57 (8.33)**	**33.43 (8.63)**

Table 6.10: Mean score distribution for value of collaborating partner in cluster

From this data, a visualisation of the industry perception towards actors in cluster can be visualised in Figure 6.3, 6.4 and 6.5 according to a triple helix perspective. A NetDraw program was used to draw the density of relationship perceived by the technology firms based on descriptive statistic data in Table 6.11. The network diagram provides clear visualisation on the image or drawing to better understand the pattern of network (Hanneman and Riddle, 2005) such as relationship value and density of technology firm with their collaborating partner rather than in numerical and text data.

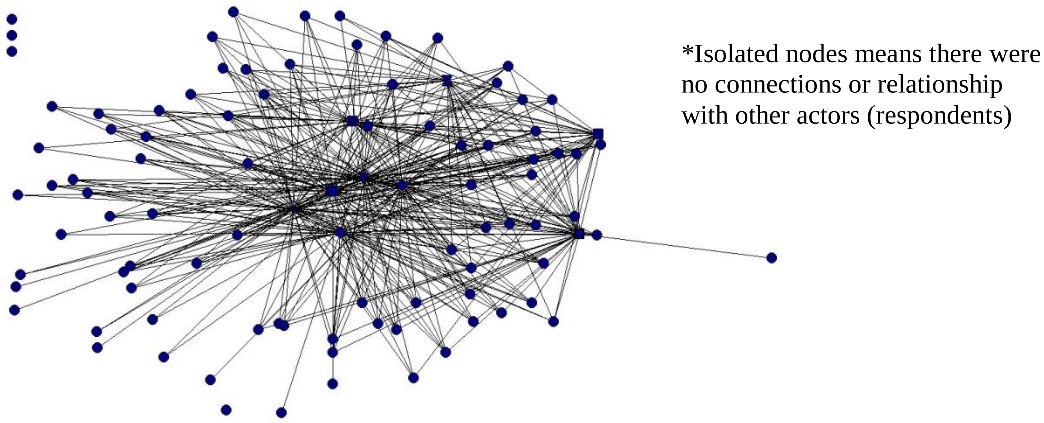
The scale of the measure has been reduced to three categories; they were (1) “strong value”, (2) “weak value” and (3) “no value”. The “strong value” data were compiled from respondents when they rate their collaborating’s partner from scale 4 (high value) to scale 5 (very high value). For ‘weak value’ data were compiled from respondents when they rate their collaborating’s partner from scale 2 (less value) to 3 (medium value). Finally, the ‘no value’ data were compiled from respondents when they rate their collaborating’s partner at scale 1 (No Value).

There are three diagram produced from the basic network drawing analysis, they are (1) strong value of relationship in Figure 6.3, (2) weak value of relationship in Figure 6.4 and (3) no value of relationship in Figure 6.5, between technology firms and the their collaborating partner like university, research and financial institutions, suppliers, intermediaries, local firms and foreign firms. Based on the density value (Table 6.11) and network drawing, it was clear that technology firms of this research perceived government, suppliers, financial institution and foreign firms are important and valuable to their business development apart from university and research institutions.

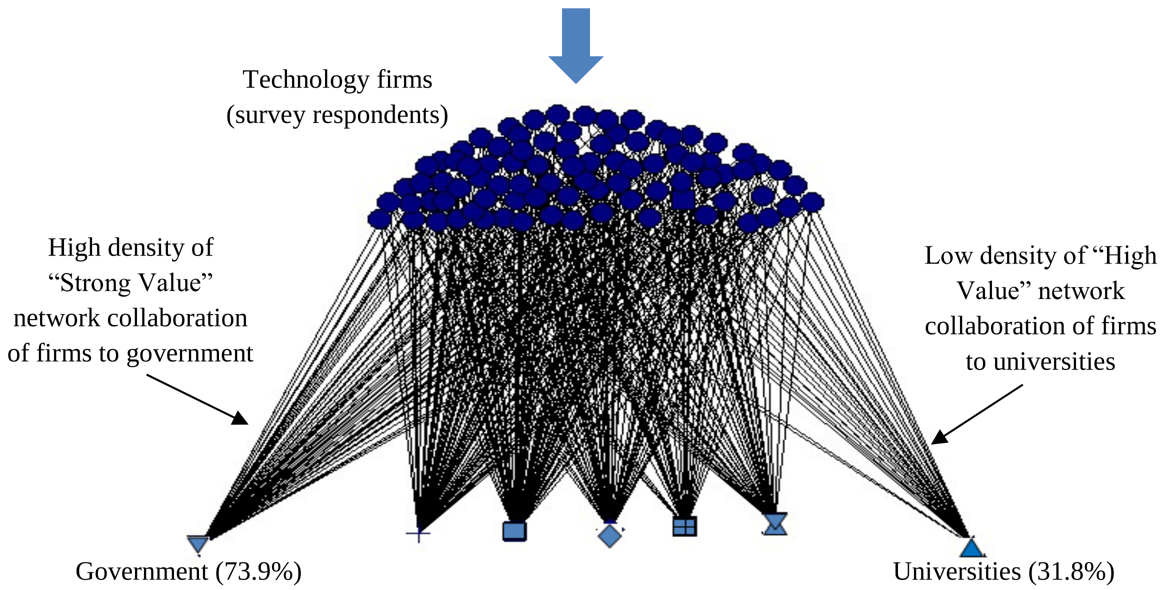
	No Value (%)	**Weak Value (%)**	**Strong Value (%)**
Foreign firms	0 (0)	27 (30.7)	61 (69.3)
Supplier	1 (1.1)	19 (21.6)	68 (77.3)
Financial	3 (3.4)	31 (35.2)	54 (61.4)
University	11 (12.5)	49 (55.7)	28 (31.8)
Research Institutions	9 (10.2)	48 (54.6)	31 (35.3)
Intermediaries	5 (5.7)	37 (42.0)	46 (52.3)
Government	1 (1.1)	22 (25.0)	65 (73.9)

Table 6.11: Distribution for density’s value of collaborating partner in cluster

It can be concluded that in general from both, the descriptive and network density drawing; the role of university and research institutions do not play an important role to technology firms as they perceived them contributing little to their progress in business. Thus, this analysis explores and presents the preliminary empirical generalisation of the important role of actors in the MSC cluster and also provides initial examination on the pattern of how technology firms perceived their collaborating partner.



Above was original result projected from network analysis drawing of “strong” relationship (respondents) based on finding in Table 6.11. This was difficult to visualise and new form of network density was projected using the same software but reconstructed based on triple helix model (see below) to simply identify the respondents connections.



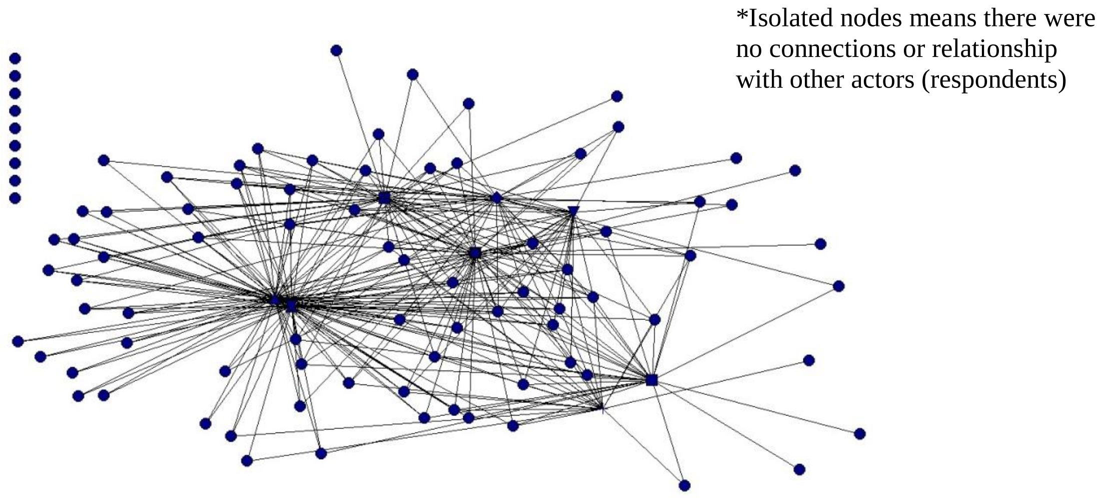
Result projected to reflect “Strong Value” of network collaboration in Triple Helix model based on finding in Table 6.11

Note:

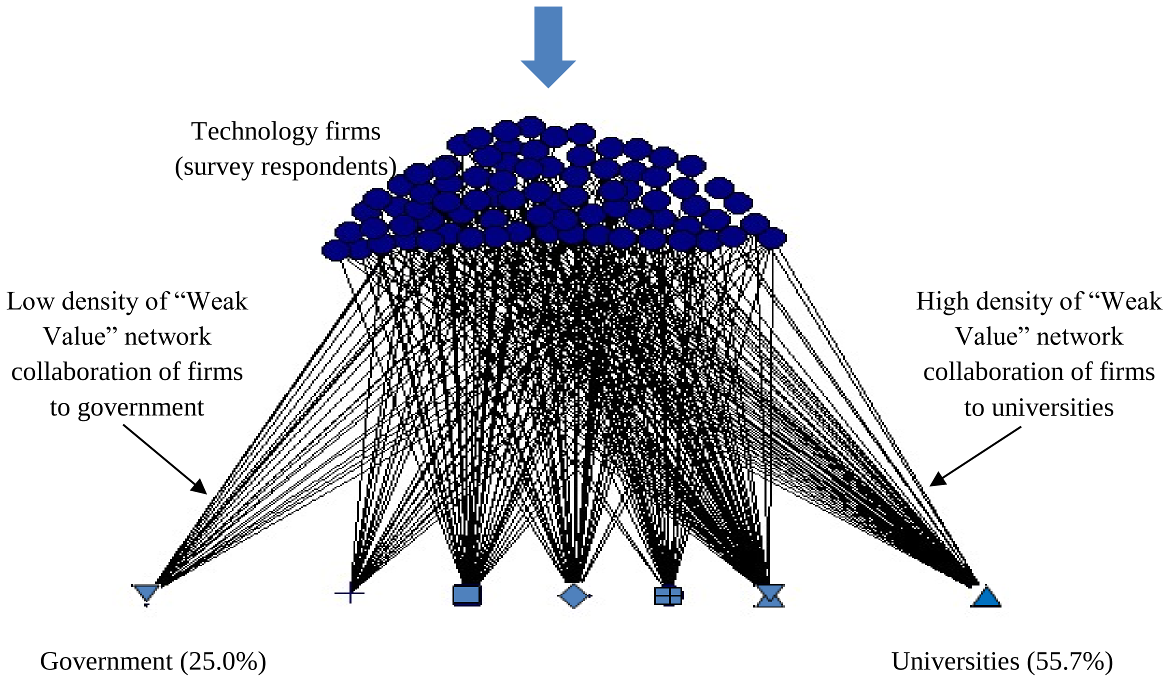
University	▲	Financial Institution	◆	Technology Firms	●
Government	▼	Research Institution	⧗	Foreign Firms	■
Supplier	+	Intermediaries	⊞		

(Source: author)

Figure 6.3: Strong value of network collaboration in MSC



Above was original result projected from network analysis drawing of “weak” relationship (respondents) based on finding in Table 6.11. This was difficult to visualise and new form of network density was projected using the same software but reconstructed based on triple helix model (see below) to simply identify the respondents connections.



Result projected to reflect “Weak Value” of network collaboration in Triple Helix model based on finding in Table 6.11

Note:

University

Government

Supplier

Financial Institution

Research Institution

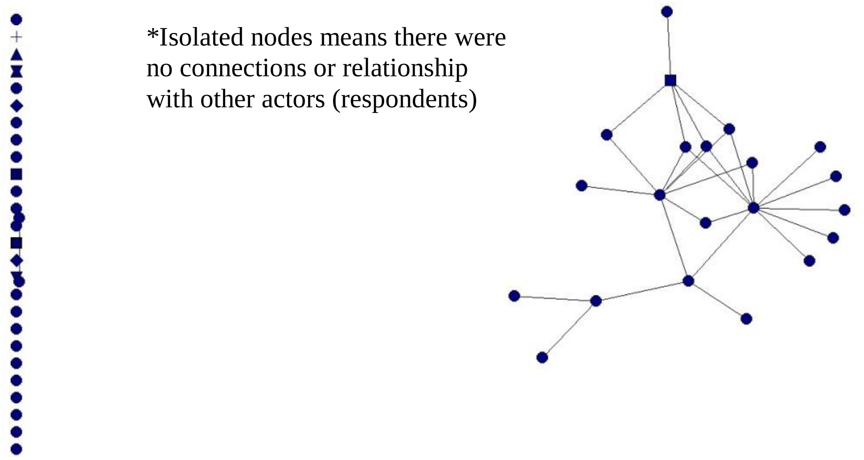
Intermediaries

Technology Firms

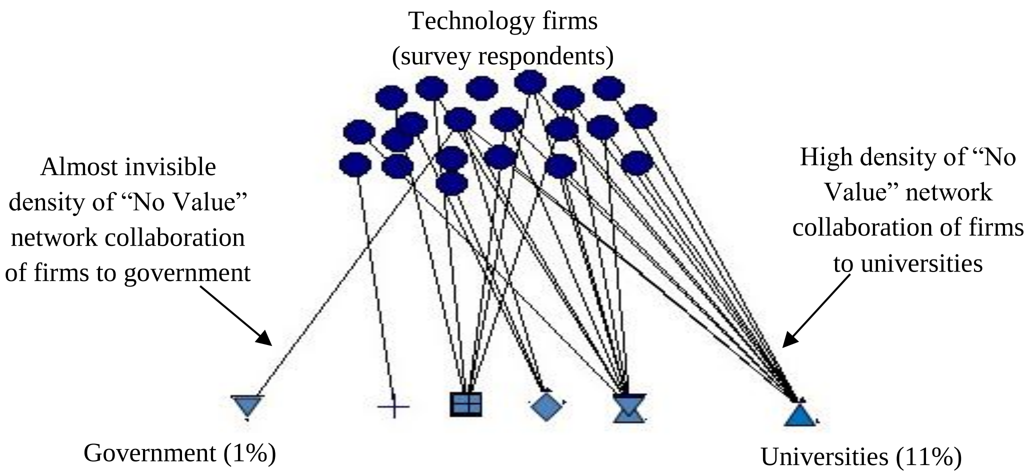
Foreign Firms

(Source: author)

Figure 6.4: Weak value of network collaboration in MSC



Above was original result projected from network analysis drawing of "no value" relationship (respondents) based on finding in Table 6.11. This was difficult to visualise and new form of network density was projected using the same software but reconstructed based on triple helix model (see below) to simply identify the respondents connections.



Result projected to reflect "No Value" of network collaboration in Triple Helix model based on finding in Table 6.11

Note:

University	Financial Institution	Technology Firms
Government	Research Institution	Foreign Firms
Supplier	Intermediaries	

(Source: author)

Figure 6.5: No value of network collaboration in MSC

6.5.2 Impact of collaboration in the cluster

In this section, respondents view on the collaboration issues were investigated, including the main motives for collaboration, the problems and issues that occurs during collaborative relationships, the possible way to enhance collaborative relationships and their opinion on collaboration in general.

6.5.2.1 Objective of collaboration

Respondents were asked to identify the main motives of why they engage in collaboration; in Table 6.12. There were 15 items asked on the main motives of why the respondents choose to collaborate. Respondents were also asked to scale the impact of these activities using a five-point Likert scale ranging from 1 (“no impact”) to 5 (“very high impact”). The majority of the respondents agreed that the primary reason of collaboration is related to the benefits of their firms in the industry. Based on the data, respondents consider collaborative activities could help their firms increase its business opportunities, with the highest mean score of 4.38. Collaboration was also a means of strategic choice of firms to improve competitiveness in the market, with a mean score of 4.27. A majority (88.6%) of respondents use collaboration as knowledge seeking activities, where they aim to improve or gain technical knowledge, with a mean score 4.26. “Source of ideas”, is another motive of respondents who choose to collaborate; mean score is 4.18. “Profit maximisation”, is the fifth main objective of collaboration; with a mean score of 4.15.

Other motives for collaboration were to be able to capitalise on opportunities for firms to benefit from government incentive and support schemes in the form of tax credit and allowance; mean score of 3.99 (which is nearly 4.00 of mean score), and 77.2% of respondents rated this motive as “High Impact” to their firms. Some referred to social motives such as increasing networking contact (mean score of 3.87), commitment and trust capability with partners (mean score of 3.80), personal recognition (mean score of 3.74) and personal objectives for idea sourcing for developing their own business (mean score of 3.63). The analyses also revealed the influence of politics (i.e. government memorandum of understanding (MoU) with other organisation purely for political reason) as part of collaboration's objective with 64.8% of respondents considered this as big impact to their organisation (mean score of 3.60). Objectives that were related to opportunity in taking advantage of a partner's technology patents and licensing, and use of advanced equipment were regarded as less important and had less impact to firm. For these two objectives, the mean scores were 3.32 and 3.30 respectively. The objective of collaboration that has less impact to respondents is the publication of research papers with mean a score of 2.67.

Overall, the technology firms in this research regard collaboration as a strategic mechanism to stay competitive in their industry and as part of knowledge seeking activities to gain and secure valuable information, ideas and practicality in relation to their determination to progress in each industry. Furthermore, issues on licensing and patent were not a priority in collaboration. This might be related to there being less availability of local technology that can be used and shared with the university as the respondents perceived the "availability of local technology" important factors for their business performance.

Objective of collaboration	Cumulative % (High Impact and above)	Overall Mean (SD)	ICT (SD)	Biotech (SD)
To increase business opportunity (e.g. connection to market)	89.70	4.38 (0.76)	4.33 (0.76)	4.47 (0.78)
Strengthen the position of your organisation in a competitive cluster of your business industry	82.90	4.27 (0.84)	4.24 (0.86)	4.33 (0.80)
Improves and gain technical skills & know-how of selected technologies	88.60	4.26 (0.69)	4.17 (0.70)	4.43 (0.63)
To develop new ideas (e.g. technology, design of product or process)	88.40	4.18 (0.69)	4.10 (0.69)	4.33 (0.66)
To achieve profit maximisation	77.30	4.15 (0.85)	4.16 (0.85)	4.13 (0.86)
Enjoy the tax benefit/credit from government (e.g. government support programme to encourage collaboration)	77.20	3.99 (0.98)	4.00 (0.92)	3.97 (1.10)
Increase social networking contact and reputation	70.50	3.87 (0.77)	3.91 (0.80)	3.80 (0.71)
To increase social commitment and trust benefit with your collaborators	69.30	3.80 (0.80)	3.71 (0.82)	3.97 (0.76)
To upgrade and increase the quality of R&D	78.20	3.77 (0.97)	3.53 (1.01)	4.23 (0.68)
To achieve self-recognition and be known by others	68.20	3.74 (0.95)	3.66 (1.00)	3.90 (0.84)
Ability to reach and choose the best and talented students to work with your organisation	50.90	3.69 (0.94)	3.62 (0.87)	3.83 (1.05)
To increase the possibility of formatting new business venture (e.g. open your own company / start-up)	61.30	3.63 (1.02)	3.55 (1.09)	3.77 (0.86)
Government influence and policy that you have to collaborate with others (e.g. sometimes government has signed the memorandum of understanding (MoU) with other international firm to improve political relationship)	64.80	3.60 (1.09)	3.47 (1.13)	3.87 (0.97)
Ability to use collaborators patent e.g. licensing of patent	50.00	3.32 (1.14)	3.12 (1.08)	3.70 (1.18)
Ability to use sophisticated and expensive technologies or equipment that your organisation do not have	44.30	3.30 (1.07)	3.16 (1.02)	3.57 (1.13)
To increase numbers of research papers publication	29.6	2.67 (1.27)	2.50 (1.26)	3.00 (1.30)
Total		**60.62 (14.83)**	**59.23 (14.86)**	**63.30 (14.31)**

Table 6.12: Mean score distribution for objective of collaboration

6.5.2.2 Barriers to collaboration

Table 6.13 shows the respondents' feedback on the barriers and limitation of collaboration and relationships between respondents and partners within the industry cluster. There were 17 items of collaborative relationship barriers listed. Respondents were asked to scale the impact using a five-point Likert scale ranging from "very high impact" to "no impact". The result reveals the greatest barriers or problems to collaboration are related to the collaboration process and objectives. The majority of the respondents agreed that bureaucracy has "very high impact" to their collaborative relationship with mean score of 4.07. Longer process of financing appeared to be the second highest barrier to collaboration with a mean score of 3.72.

Limitation of skills was found to be another major barrier to collaboration. These limitation included variety of local skills (mean score of 3.72), commercialisation skills (mean score of 3.67) and availability of local technology (mean score of 3.53). The lack of R&D equipment and different interest of collaborators also seems to be problem in collaboration with both mean score of 3.36. This indicates that there are not enough R&D activities because there are limited facilities and equipment that can be obtained and utilise, thus contributes to the limitation of collaboration in the MSC. In order to continue the R&D activities, the firms collaborate with other so that they can use their collaborator's equipment or facilities (as was found motive of firms to collaboration indicated in Table 6.12, Section 6.5.2.2).

Other collaborative problems gave less impact to the majority of respondents. They included the influence of large and foreign firms, knowledge sharing, personal objectives, local culture and physical location of premises. Respondents also agreed that unclear policy and guidelines for patents is one of the barriers for collaboration; however it gives less impact to the firm and is not a major problem that needs to be resolved. This indicates at current policy and guidelines are in favour of collaboration. The results are consistent with respondent's practices in gift-giving or reward practices; with lowest mean score of 2.97. This shows that respondents have little concern over personal reasons and a bribery culture to assure them it would not be a barrier in collaboration.

Overall, the data shown in Table 6.9 reveals various barriers and challenges for respondents in developing healthy and effective collaboration. Clearly bureaucracy is regarded as the major obstacle for collaboration. Some loosen-up of the boundaries between partners could possibly enhance the collaborative relationship among actors. Also, the difficulties that occur for collaboration are related to the conditions of cluster determinants, which represent the factors that could support firm's formation and development in cluster. This provide explanation on why technology firms are facing problems in collaborative relationship activities, as the condition of the cluster is incomplete or elements could still not exist.

Problem or barrier of collaboration	Cumulative % (High Impact and above)	Overall Mean (SD)	ICT (SD)	Biotech (SD)
Bureaucratic and too many authorisation causes longer time to start collaboration work	76.1	4.07 (0.93)	3.98 (0.85)	4.23 (1.07)
Longer process of financing start from submit application to receiving the funds	62.5	3.72 (0.97)	3.64 (0.91)	3.87 (1.07)
Limitation of local skills contribution in collaboration	57.9	3.68 (0.90)	3.66 (0.89)	3.73 (0.94)
Inexperience and difficulty in connecting to market (e.g. marketing and commercialisation activities)	63.6	3.67 (0.93)	3.60 (0.90)	3.80 (1.00)
Limitation of local technology contribution in collaboration	53.4	3.53 (0.91)	3.47 (0.90)	3.67 (0.92)
Time consuming to achieve mutual agreement between collaborators	56.8	3.49 (0.95)	3.41 (0.94)	3.63 (0.96)
Lack of R&D equipment and expertise	53.4	3.36 (1.06)	3.28 (1.04)	3.53 (1.10)
Different interest and objectives of collaborators	50.0	3.36 (1.07)	3.43 (1.06)	3.23 (1.10)
Different interest of venture capitalist /investor	44.8	3.33 (1.08)	3.26 (1.03)	3.47 (1.20)
The influence of external/foreign organisations or large organisation in business environment.	47.7	3.30 (1.06)	3.36 (1.05)	3.17 (1.08)
Inability to share the information with others except with close friends / contacts	38.6	3.30 (0.98)	3.14 (0.91)	3.60 (1.07)
Too much secrecy and curiosity in sharing information	38.6	3.28 (1.07)	3.22 (1.04)	3.40 (1.13)
Priority of collaboration is just to get self-recognition and sense of achievement	38.7	3.14 (1.02)	3.09 (0.94)	3.23 (1.16)
Lack of understanding in norms, values, practices and environment of collaborators	35.6	3.13 (0.92)	3.14 (0.98)	3.13 (0.82)
Geographic location of collaborators	34.1	3.09 (1.06)	3.02 (1.08)	3.23 (1.00)
Unclear policy and guidelines of using patent	35.3	3.08 (1.10)	3.05 (1.05)	3.13 (1.22)
Gift-giving or reward practices (favour to the other parties when sharing or passing new method or process or formula)	31.9	2.97 (1.11)	2.95 (1.11)	3.00 (1.11)
Total		**57.50 (17.12)**	**56.70 (16.68)**	**59.05 (17.95)**

Table 6.13: Mean score distribution for problem of collaborative relationship

6.5.2.3 Potential elements to enhance impact of collaboration in the future

Respondents were asked their opinion on items related to enhancing collaboration and relationships with collaborative partners. There were 11 items developed indicating the elements of input, process and support of enhancing collaboration activities in the future. Respondents were also asked to scale the impact of the item using a five-point

Likert scale ranging from “very important” to “not important”. Table 6.13 shows the mean distribution for potential elements to enhance future collaboration from respondents’ views.

The majority of the respondents seemed concern about the importance of skills. Respondents agreed that by focusing on the quality and performance of local education system along with local technology, the production and quality of local skills could be improved. For these two reasons, the mean score was 4.10 each. The support from industry in collaborative activities with local education institution could also be seen as an element to expedite the collaboration process. However, this element could take some period of time to work.

The role of government in providing a balanced business ecosystem including the infrastructure’s support also perceived as important to promote collaboration with a mean score of 3.99. Other than that, the effective role played by intermediaries (i.e. trade association, commercialisation and industry support agencies) was seen as important in the collaboration process. For this, the mean score was 3.85. It was agreed that improving conditions for local entrepreneur’s, including their acumen in business skills and experiences was regarded as important and significant to collaboration with mean score of 3.83. The data also indicated that more than 60% of respondents agreed that the existence of input and interest of venture capitalist are important and could enhance the collaboration among actors in industry cluster. Respondents rated this element with mean score of 3.76.

The data show that social elements were perceived as important and could help in promoting the collaboration process in cluster. This social elements including actively involved in social networking and trust’s value (i.e. competency and capability) among partners recorded a mean score of 3.75 each. The issues of intellectual property and patent were seen as important (rated by more than 50% of respondents) and encouraged firms to collaborate, however it depended on the existence of clear and effective policy. For this reason, the mean score was 3.61.

The final element that could enhance collaboration was the input of collaboration itself, particularly on number of contracts signed or projects involved, with a mean score of 3.57. This indicates that respondents were confidence to join collaborative work if the partner has a lot of experience by looking at the history of collaborative contracts signed and involved.

Potential Elements	Cumulative % (High Impact and above)	Overall Mean (SD)	ICT (SD)	Biotech (SD)
The quality of local education system and training availability	78.4	4.10 (0.87)	4.12 (0.92)	4.07 (0.78)
Availability and quality of current technology	81.9	4.10 (0.80)	4.14 (0.80)	4.03 (0.81)
Existence and quality of local infrastructure	73.8	3.99 (0.75)	4.10 (0.76)	3.77 (0.68)
Active support from local intermediaries to support the commercialisation process (e.g. role of Multimedia Dev. Corporation, Biotech Corporation, MIDA & others)	68.2	3.85 (0.89)	3.84 (0.89)	3.87 (0.90)
Quality of local entrepreneurs (e.g. behaviour, skills, experience)	65.9	3.83 (0.85)	3.90 (0.89)	3.70 (0.75)
Existence and interest of local venture capital participation	68.2	3.76 (0.95)	3.72 (0.93)	3.83 (0.99)
Active participation in social networking activities	62.5	3.75 (0.94)	3.78 (0.94)	3.70 (0.95)
Degree of competence and commitment of trust among collaborators	64.8	3.75 (0.78)	3.78 (0.82)	3.70 (0.70)
Availability and interest of international venture capital participation	64.8	3.72 (0.89)	3.78 (0.94)	3.60 (0.81)
Clear direction and effective policy on intellectual property right	56.8	3.61 (0.94)	3.59 (0.95)	3.67 (0.92)
Numbers of collaborations contracts or projects involves	53.4	3.57 (1.00)	3.69 (0.96)	3.33 (1.06)
Total		**42.03 (9.66)**	**42.44 (9.80)**	**41.27 (9.35)**

Table 6.14: Mean score distribution for potential solution of collaborative relationship

6.5.2.4 Other issues discovered

Respondents were asked in open-ended question’s format for their comment and view on issues related to collaboration in their industry cluster. There was little in way of contribution from the respondents with only 12.5% participation. The majority of the respondents participated in this section indicated that collaboration between university-industry-government could support the development of the industry cluster particularly development and support of firms in the MSC cluster in Malaysia. However, the respondents feel that there were challenges and barriers that need to be overcome including issues on bureaucracy, focus and commitment in collaboration activities, trust among partners, social and financial support from the local government, social networking participation and local skills gap. One of the respondent suggested that the role of university should be *'more active and visible'*. Respondents believed that collaboration could contribute towards producing *'well-practiced fresh graduates'* and knowledge transfer activities.

6.6 DIFFERENTIATING FIRMS FROM ICT AND BIOTECH INDUSTRY

As most of the responses are in the form of a Likert scale (categorical variables), the non-parametric analysis of Mann-Whitney U test was performed to identify whether any differences between the firms from the ICT and Biotechnology industry in the MSC. Although some of mean scores for each variable showed differences between the two types of industry, the Mann-Whitney U test could further check, prove and confirm whether the variables has a significant differences. There are six hypotheses developed to test if there are any differences between the ICT and Biotech industry samples. Based on literature reviewed during the course of this research, it is assumed (null-hypotheses) that there are no significant differences between firms from ICT and Biotech industries in: (H1) important factors of firm's formation, (H2) impact of local factors, (H3) value of collaborator's partner, (H4) objectives or motives of collaboration, (H5) impact of barriers of collaboration, and (H6) impact of potential elements to enhance collaboration in the future. These six hypotheses are related to answer the research question and objectives (Section 1.3 and 5.2) which the outline for strategy of inquiry of achieving each research objectives has been identified in Section 5.10. Therefore, the policy adviser would have some guideline to plan on its project's development activities and investment based on categories of firms i.e. ICT or Biotech. Table 6.15 show the hypotheses and the result of the test. The significance value which is indicated by the *p* value is used at the level of $p < 0.01$ (99% confidence level). From the test, it was found that there were two hypotheses were rejected i.e. H1 and H4, while the remaining four hypotheses (H2, H3, H5 and H6) were accepted.

Hypothesis		**Result**
H1	There are no significant differences in important factors of firm's formation among firms from ICT industry with Biotech industry in MSC.	Rejected
H2	There are no significant differences in impact of local factors among firms from ICT industry with Biotech industry in MSC.	Accepted
H3	There are no significant differences in value of collaborator's partner among firms from ICT industry with Biotech industry in MSC.	Accepted
H4	There are no significant differences in motives or objectives of collaborations among firms from ICT industry with Biotech industry in MSC.	Rejected
H5	There are no significant differences in impact of barriers on collaborations with firms from ICT industry and Biotech industry in MSC.	Accepted
H6	There are no significant differences in impact of potential elements to enhance collaborations in the future with firms from ICT industry and Biotech industry in MSC.	Accepted

Table 6.15: Result of hypothesis testing based on Mann-Whitney U test

6.6.1 Firms Development and Formation in the MSC

The Mann-Whitney U test found (Table 6.16) that there was significant at 99% of confidence level ($p < 0.01$) for firm's development and formation in the MSC. As expected, the variable of involvement and allocation on R&D for Biotech is higher than ICT. The statistical significance value was 0.005, where *p* at 1% level. The mean rank difference between the two industry was 15.40; and median score was Biotech = 5 (very important) and ICT = 4 (important). This result confirmed the output from descriptive statistics analysis (Table 6.6, Section 6.5.1.4) where mean score for Biotech on variables of involvement and allocation on R&D was 4.27 higher than mean score for ICT which was 3.64. There are three variables were found less significant (location, connection to market and issues on IP) and the remaining eight variables were found not significant.

In conclusion, firms from the Biotech industry require more attention and support for the development of firms in the MSC than firms from ICT. Possible explanations for this could be the nature of the business itself (Biotech) which requires greater emphasis on the research and development activities. Also in order to commercialise and connect product research to the desired market, the protection of the product design or process with the approved IP and patent's application are necessary for firms to stay competitive. Firms from the Biotech industry perceived the location factor as important since the close proximity with customer and supplier can enhance the innovation and technological progress through knowledge transfer and networking activities. The descriptive statistics reveals that Biotech firms find it is not as easy to reach suppliers compared to ICT firms. Also, firms from the Biotech industry find it is difficult to get local support compared to the ICT industry; with mean scores of 2.93 and 3.12 respectively (Table 6.9). The results and arguments above explains the difficulties that the Biotech industry experiences, therefore, they feel that the factor of firm's formation is more important for their progress than firms from the ICT industry. By comparing firms from two industries, one objective has different impact on collaboration and therefore the hypothesis was rejected.

Factors of firm's formation (cluster determinants)	Median		Mean Rank		Mann-Whitney U	Wilcoxon W	*z* value	*p* value
	ICT (n=58)	Biotech (n=30)	ICT (n=58)	Biotech (n=30)				
Close relationship with university	3	3	41.56	50.18	699.5000	2410.500	-1.541	0.123
Close relationship with industry	4	4	45.55	42.47	809.000	1274.000	-0.576	0.565
Close relationship with government's agencies	4	4	44.82	43.88	851.500	1316.500	-0.178	0.859
Availability and quality of local entrepreneurs and skills	4	4	43.26	46.90	798.000	2509.000	-0.673	0.501
Availability of technology	5	4	43.76	45.93	827.000	2538.000	-0.406	0.685
Availability of financial support	4	5	42.12	49.10	732.000	2443.000	-1.278	0.201
Physical location of premises	3	4	41.14	51.00	675.000	2386.000	-1.828	0.068*
Involvement and allocation of R&D	4	5	39.25	54.65	565.500	2276.500	-2.801	0.005***
Connection to market	4	5	40.24	52.73	623.000	2334.000	-2.354	0.019**
Issues on IP	4	5	40.33	52.57	628.000	2339.000	-2.226	0.026**
Government policy, support & regulations	4	5	42.50	48.37	754.000	2465.000	-1.147	0.251
Culture issues including trust	4	4	45.72	42.15	799.500	1264.500	-0.675	0.499

Note:
** significant at 10% level (p < 0.1), ** significant at 5% level (p < 0.05), *** significant at 1% level (p < 0.01)*
median 3 = medium important, median 4 = important, median 5 = very important

Table 6.16: Mann-Whitney U Test for firms in ICT and Biotech industry on cluster determinants

6.6.2 Objectives of Collaboration in the MSC

The Mann-Whitney U tests conducted found that there were two variables significant at 99% confidence level ($p < 0.01$) on the objective of collaboration, and the test could indicate and identify which industry found it more important than the other (Table 6.18). They were (1) improve quality of R&D and (2) ability to use patent, have statistical significant at 1% level with value $p = 0.002$ and $p = 0.008$ respectively. Again, the test shows that firms from Biotech industry has higher mean rank score by 16.99 and 14.49 accordingly. These differences score can be considered quite high at 99% confidence level. The descriptive statistic result (Table 6.12, Section 6.5.2.1) also in-line with this test with the mean score from Biotech was 4.23 (ICT = 3.53) for improve R&D and 3.57 (ICT = 3.16) for ability to use patent. A possible explanation for these differences may be related to the difficulties occurs by firms from Biotech industry on factors affecting to firm's progress and performance than ICT industry. This does not mean that ICT industry does not find it is hard or important, but less critical than expected by Biotech industry. In reducing the risk and difficulties, collaboration was used as strategic mechanism for firms to progress and perform. The rest of the variables on the objective of collaboration were found not significant with three variable (improve and gain knowledge, ability to use equipment and facilities, and research publications) were found less significant i.e. $p < 0.05$ than the significant level used for this test ($p < 0.01$). Therefore, by comparing firms from two industries two objectives have different impact on collaboration and the hypothesis was rejected.

For the other four hypotheses (Table 6.16), the Mann-Whitney U tests conducted found that there were not significant. Consequently, each variable has the similar impact on (H2) local factors impact of local factors, (H3) value of collaborator's partner, (H5) impact of barriers of collaboration, and (H6) impact of potential elements to enhance collaboration in the future. Appendix 7 revealed the test result.

Objectives / Motives of collaboration	Median		Mean Rank		Mann-Whitney U	Wilcoxon W	*z* value	*p* value
	ICT (n=58)	Biotech (n=30)	ICT (n=58)	Biotech (n=30)				
To increase business opportunity (e.g. connection to market)	4	5	42.66	48.05	763.500	2474.500	-1.043	0.297
Strengthen the position of your organisation in a competitive cluster of your business industry	4	5	43.69	46.07	823.000	2534.000	-0.450	0.653
Improves and gain technical skills & know-how of selected technologies	4	5	41.53	50.23	698.00	2409.000	-1.676	0.094*
To develop new ideas (e.g. technology, design of product or process)	4	4	41.88	49.57	718.000	2429.000	-1.487	0.137
To achieve profit maximisation	4	4	44.82	43.88	851.500	1316.500	-0.174	0.862
Enjoy the tax benefit/credit from government (e.g. government support programme to encourage collaboration)	4	4	44.28	44.92	857.500	2568.500	-0.117	0.907
Increase social networking contact and reputation	4	4	45.72	42.15	799.500	1264.500	-0.674	0.501
To increase social commitment and trust benefit with your collaborators	4	4	41.99	49.35	724.500	2435.500	-1.399	0.162
To upgrade and increase the quality of R&D	4	4	38.71	55.70	534.000	2245.000	-3.143	0.002***
To achieve self-recognition and be known by others	4	4	43.00	47.40	783.000	2494.000	-0.823	0.411
Ability to reach and choose the best and talented students to work with your organisation	4	4	42.24	48.87	739.000	2450.000	-1.221	0.222
To increase the possibility of formatting new business venture (e.g. open your own company / start-up)	4	4	41.88	49.57	798.500	2509.500	-0.662	0.508
Government influence and policy that you have to collaborate with others	4	4	41.70	49.92	707.500	418.500	-1.516	0.130
Ability to use collaborators patent e.g. licensing of patent	3	4	39.56	54.05	583.500	2294.500	-2.633	0.008***
Ability to use sophisticated and expensive technologies or equipment that your organisation do not have	3	4	40.92	51.42	662.500	2373.500	-1.905	0.057*
To increase numbers of research papers publication	2	3	41.23	50.82	680.500	2391.500	-1.711	0.087*

Note:
** significant at 10% level (p < 0.1), ** significant at 5% level (p < 0.05), *** significant at 1% level (p < 0.01)*
median 2 = less important, median 3 = medium important, median 4 = important, median 5 = very important

Table 6.18: Mann-Whitney U Tests for firms in ICT and Biotech industry on objectives and motives of collaboration in the cluster

6.7 INTERPRETING THE SURVEY DATA

The analysis from the survey data provides valuable information to determine the critical importance and impact value of the factors related to cluster development (i.e. main determinants, local operation factors and impact value of collaborative partner) and collaborative relationship issues (i.e. objectives and barriers of collaboration). This analysis also aims to identify the "fitness" of the factors based on the conceptual model, and identify the critical factors worthy of further investigation in interview sessions.

The survey data was based on a 42% response rate of technology companies (ICT and Biotech) operating their business within proximity of MSC that have experience in having collaborative arrangements with universities and government agencies. Characteristic of the respondents include the employment status, ownership and recognition status of the firm; and size of firms (number of employees and years of existence), which are presented in Table 6.2. The analyses for the survey data include univariate descriptive statistical, basic network drawing analysis and non-parametric analysis. Based on these analyses, the survey data was interpreted to meet the outcome needed for the research question and objectives.

The role of innovative policies i.e. status recognition given to firms were regarded important in supporting progress of firms in financial issues. There is a need for further explanation on other supporting role by government and particular role of universities as the survey data revealed firms have less interest in having close interaction and linkages with universities (Table 6.6). Further interesting findings regarding the condition of local operation factors were also presented (Table 6.7) by measuring the satisfaction level. These outcomes could be interpreted and used by local policy advisers in improving the condition of the local innovation system. However in-depth explanation on why, how and what makes the local operation factors varies in their own satisfactory level needs to be expanded upon, and this can be further investigated using the qualitative method (Chapter 7).

To summarise, a bar graph has been produced to identify and illustrate the position of the factors based on importance and impact to the organisation, with the number of respondents highlighted (Figure 6.6). It is found that there are gaps between the role of university and intermediaries (low impact/medium importance) related to their collaborative relationship as compare to the role of industry and government (high impact/high importance). The graph also shows that with collaboration there is a possibility that the quality of education and technology and knowledge skill production could be improved with a resultant high degree of impact in the future. This prompted the deeper investigation of the role of triple helix stakeholders; university, industry, intermediary and government and how their collaborative relationships contribute to the MSC cluster development.

The conceptual model of this research has been used for the survey data findings and analysis. A summary of the survey data analysis is conceptualised in Figure 6.7 using the elements of conceptual modelling in this research. The thickness of the line indicates higher impact or importance of the factors based on the mean score and cumulative percentage of the impact score of the survey. This version of the model is representative of the status of the MSC cluster, where the initial conceptual model is generic i.e. has no dynamic elements to indicate weightings from a real world case.

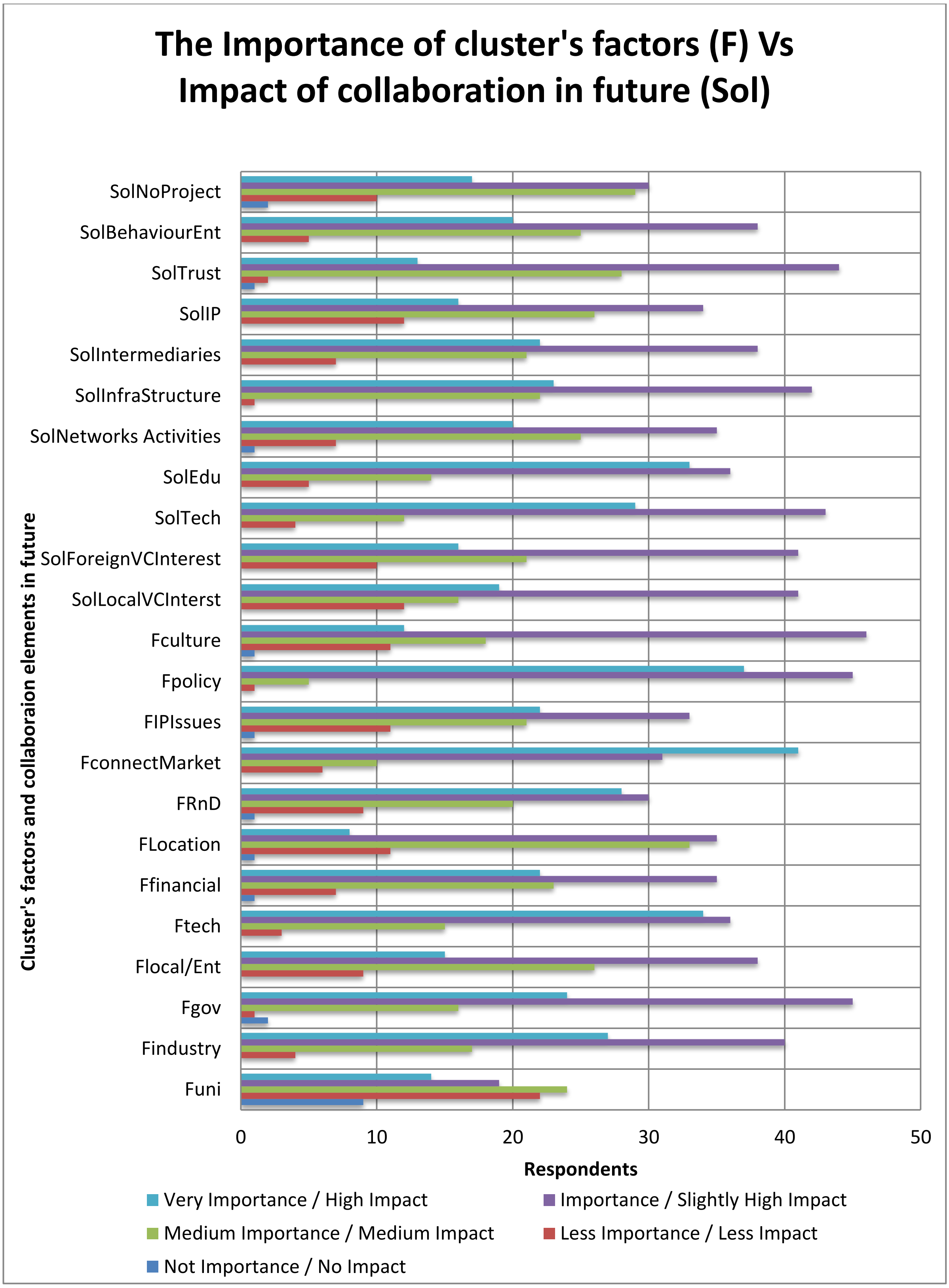


Figure 6.6: The importance of cluster's factors (F) versus impact of future collaboration (Sol)

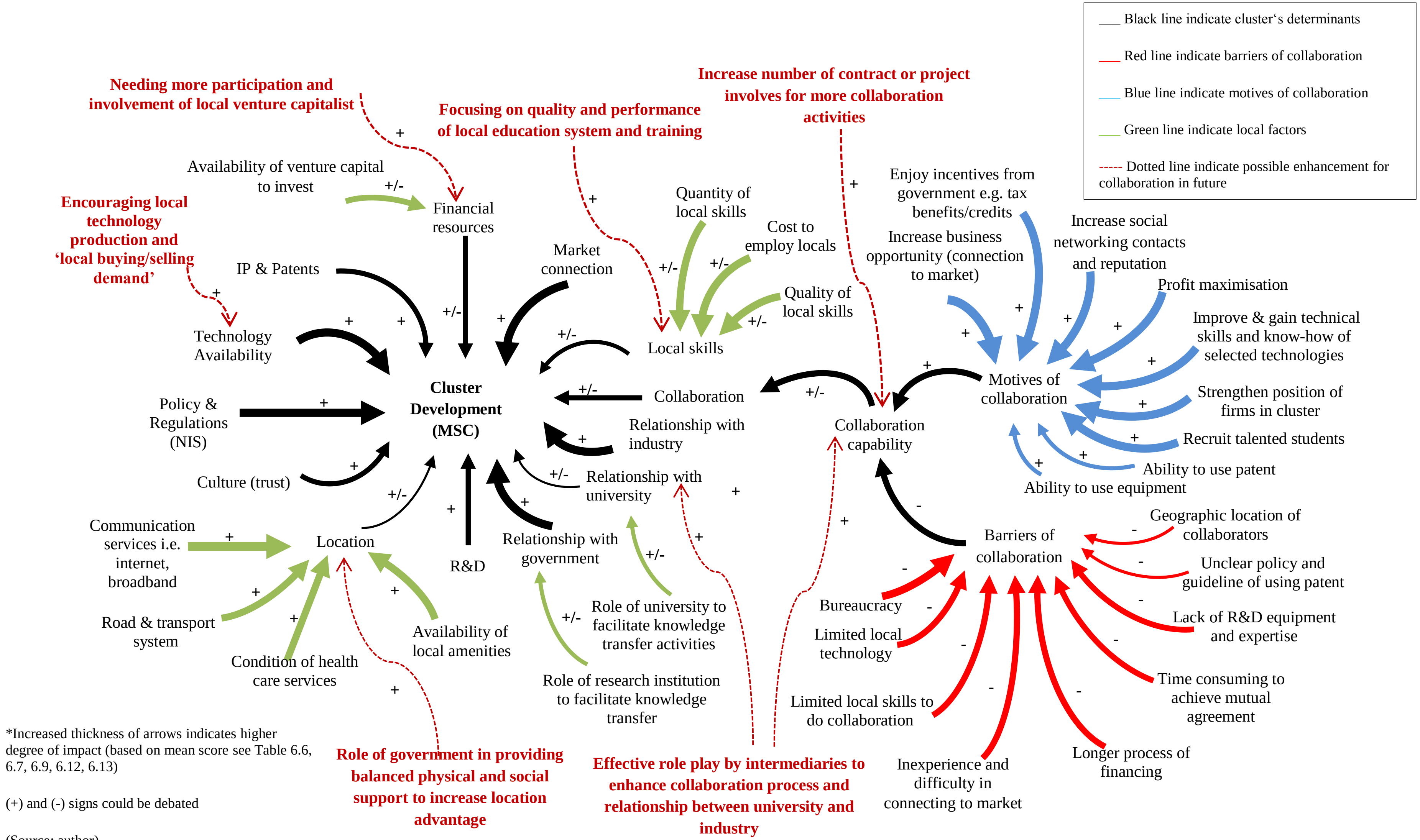


Figure 6.7: Summary of survey data analysis based on influence diagram and conceptual model

CHAPTER 7

QUALITATIVE DATA AND ANALYSIS

7.1 INTRODUCTION

This chapter presents the qualitative data following the fieldwork in Malaysia. The data were gathered from 21 semi structured face-to-face interviews. The objective of qualitative data is to provide in depth explanation and meaning from the quantitative data of the cluster phenomena and collaboration issues in Malaysia. In a way, triangulation approach is used to corroborate both quantitative and qualitative findings. There is cross references of quantitative data from Chapter 6 linked to qualitative data for the purpose of triangulation.

This chapter was structured start from the process of how the qualitative data were analysed and follow by the background of the interviewees involved in this research. Later, the cluster phenomena and collaboration issues of Malaysia were presented and analysed. The summary of the discussion were illustrated with the use of influence diagram to enhance the links and understanding of the issues discussed.

7.2 PROCESS OF QUALITATIVE DATA AND ANALYSIS

As previously mentioned in Section 5.6.3, the interview instrument was used to collect another set of primary data through qualitative method in the mixed method research. Since this research philosophical view is pragmatism, the research is determine to answer the research question addressed with using all necessary research applications and instruments (Creswell, 2009) so that the research problems can be further understand in depth. Thus, the qualitative data could support the findings from quantitative methods, which was presented in Chapter 6 and the application of mixed method research could provide this research to explore greater depth explanation of the problem addressed (Tashakkori and Teddie, 2003).

The purposive sampling technique was used for this research, as mentioned in Section 5.8.1 with objective to target a group of people that represent the triple helix actors and be able to provide information and share their experiences on collaboration and relationship with their collaborative partner in cluster. The fieldwork was conducted in Malaysia with interview respondents from varied background that are related to the characteristic of the research sample. They include position held in organisation, type of actors in cluster and type of organisation as shown in Table 7.1. In total, there were 21 sample of interviewees were interviewed, who came from 16 different organisations include 4 universities, 6 technology firms from ICT & Biotechnology industry, 2 local financial institutions, 2 local intermediaries and 2 government agencies for this research. The interviews session took approximately between 45 to 120 minutes.

Before the interview session started, each of the interviewees were asked their permission to record the interview session with voice recorder and explained the confidentiality issues and usage of the information provided. However not all of the interviewees agreed to record the interview session. The interviews were conducted in English language rather than Malay language as the interviewees are all confident to converse in English language and its usage as second language in Malaysia. There are also some Malay words been used by the interviewees during the interview session but later been translated into English language. The recorded interviews were translate and transcript all in English language.

The qualitative data were analysed manually but also used computer program which was QSR NVivo 10 to assist analysed the text data. The process of qualitative data analysis is shown as in Figure 7.1 start from the raw data gathered through transcript, field notes and observation during the fieldwork. The data later were thoroughly read to get generalisation and familiarisation which contributes for the coding process of data. The coding process starts with open coding the data with computer assisted based on words and phrases that can be correlated with the research questions and objectives of the research. Later, themes coding were processed according to similar pattern and themes discovered based on the data and literature review. To ensure the validity and relatedness of the data according to thematic categories, the themes coding were read thoroughly several times. Finally, the processes of interpreting the meaning of themes were done to making sense of the data. The influence diagrams were used to displayed and visualise the content analysis of the qualitative data in related to MSC cluster and collaboration issues among stakeholders involves of the research.

List of themes used were: (1) technology cluster status; (2) technology availability and position; (3) differentiating the MSC with other; (4) contributions of the MSC; (5) role of university; (6) role of industry (firms); (7) role of government; (8) role of intermediaries; (9) motives of collaboration; (10) challenges and barriers of collaborations; and (11) entrepreneurial university status.

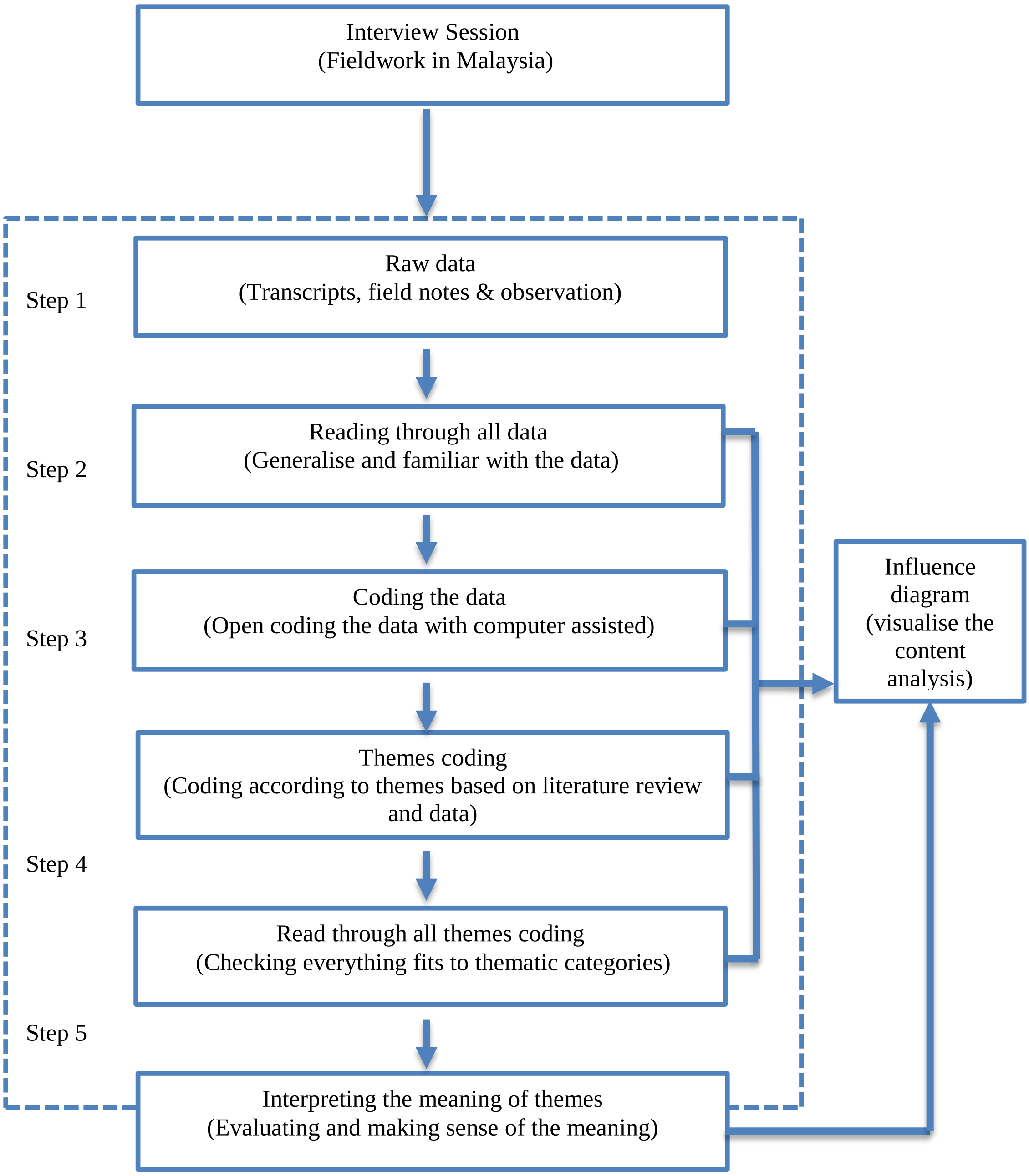


Figure 7.1: Process of qualitative data analysis (Source: author)

No.	Interview Respondents	Code	Position Held	Organisation (University/Industry/Ministry)
1.	University	Uni1	Professor & Director of Centre	Multimedia University Malaysia (MMU)
2.	University	Uni2	Associate Professor & Director of Centre	University Tenaga National (UNITEN)
3.	University	Uni3	Associate Professor & Director of Centre	University Kuala Lumpur (UNIKL)
4.	University	Uni4	Senior Lecturer & Director of Centre	University Technology MARA Malaysia (UITM)
5.	Industry	Ind1	CEO	ICT Companies – Telecommunication & Software
6.	Industry	Ind2	CEO	ICT Companies – Telecommunication & Software
7.	Industry	Ind3	Managing Director	ICT Companies – Telecommunication, Hardware & Software
8.	Industry	Ind4	Senior Manager	ICT Companies
9.	Industry	Ind5	Senior Manager	Biotechnology Companies - Pharmaceutical
10.	Industry	Ind6	Senior Manager	Biotechnology Companies – Palm Oil
11.	Intermediaries	Int1-A	Head of Department	Multimedia Development Corporation Sdn Bhd
12.	Intermediaries	Int1-B	Head of Department	Multimedia Development Corporation Sdn Bhd
13.	Intermediaries	Int2	Head of Department	Multimedia Development Corporation Sdn Bhd
14.	Intermediaries	Int3	Head of Centre	Technology Park Malaysia Sdn Bhd
15.	Intermediaries	Int3	Senior Manager	Technology Park Malaysia Sdn Bhd
16.	Financial Institution	Fin1	CEO	Local Bank
17.	Financial Institution	Fin2	Head of Department	Local Bank
18.	Government	Gov1	Senior Director	Ministry of Science, Technology & Innovation
19.	Government	Gov2	Director	Ministry of Science, Technology & Innovation
20.	Government	Gov3	Deputy Director	Ministry of Science, Technology & Innovation
21.	Government	Gov4	Senior Director	Ministry of International Trade & Investment

Table 7.1: Background of interview participants

Following the process of qualitative data analyses, there are four major sections (Figure 7.2) presenting the analysed qualitative data, where consist of eleven themes used in the analyses process. They were:

Section 7.3: Accessing the MSC from the actors view

Section 7.4: Actor and role in the MSC

Section 7.5: Collaboration in the MSC

Section 7.6: Other issues discovered: Entrepreneurial University

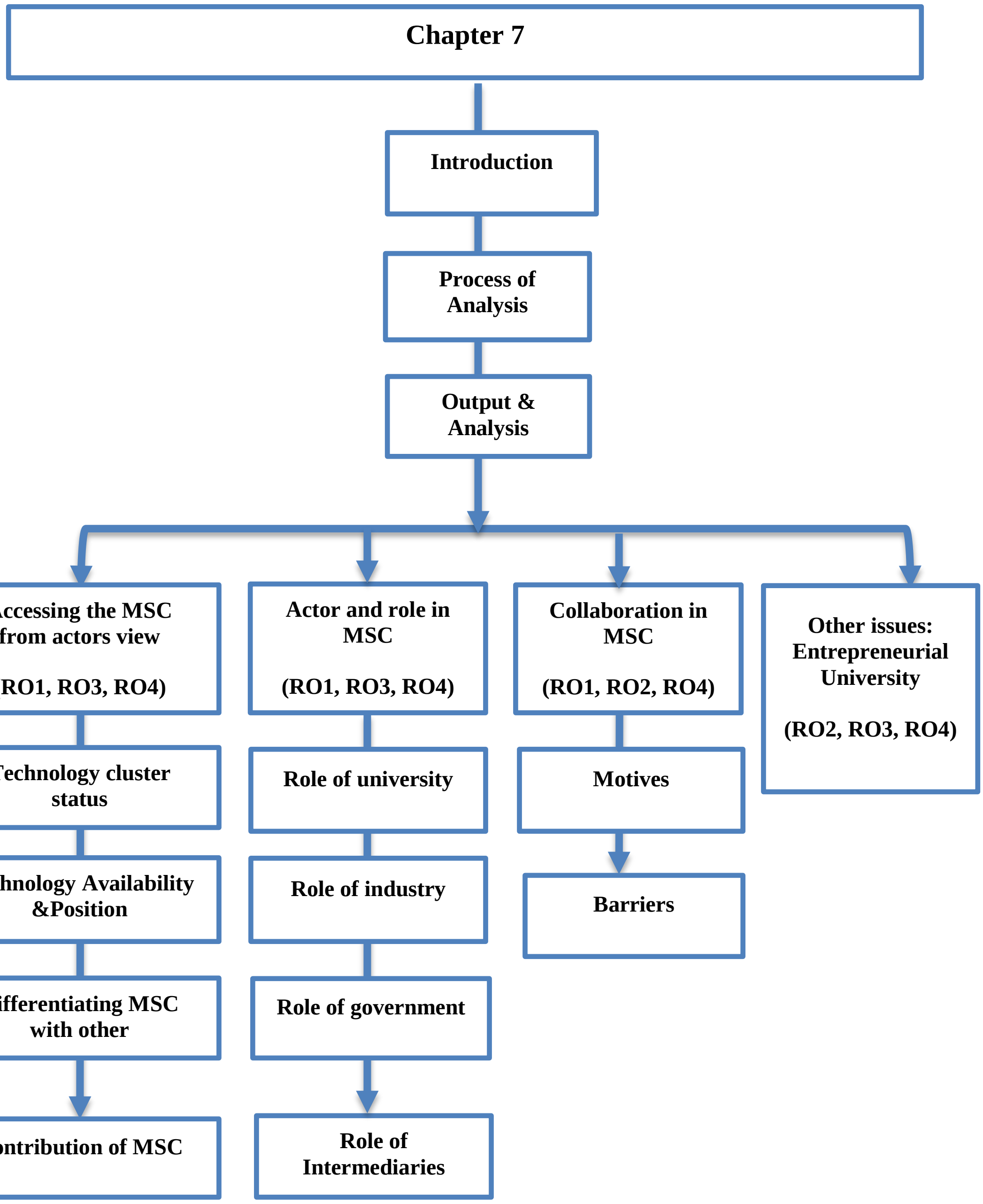


Figure 7.2: Framework of Chapter 7

7.3 ASSESSING THE MSC CLUSTER FROM THE ACTORS VIEW

This section will discuss the views reported by respondents regarding the state of the MSC. The topics covered included the status of the MSC as a technology cluster, and the availability and position of local technology.

7.3.1 MSC cluster status

It is crucial to identify the current state of the MSC cluster. One of the ways to measure this is by discussing with the selected actors issues and challenges they experienced. Issues uncovered could potentially be used in planning future development and performance improvement of the cluster itself. The analyses reveal that the MSC cluster is still in a development stage and far from being a viable technology cluster even after 15 years from launch. A majority of interviewees indicated that the MSC was far behind schedule to achieve a functioning technology cluster status. Both interviewees from industry, Ind4 and Ind5, believed that the MSC is not a technology cluster in the current state:

> *"Not at the moment. We could achieved it in the future and we need more time in putting things forward like developing talent and technology" (Ind4).*
>
> *"I'm optimistic that given time it can achieve but at the moment it is not a cluster" (Ind5).*

However, both agreed that it may be achievable in future by filling in the gaps with continuous development of local talent and technology.

As mentioned in Section 2.3.3, a location advantage is one of components indicative of the success of a cluster. In contrast, the survey data in presented earlier revealed that 51.1% of survey respondents did not consider location as important for their firm development. This was supported further by the interview data where the interviewees are concerned with the attractiveness of Cyberjaya (main city of MSC) compared with Kuala Lumpur (main financial capital city of Malaysia) especially because of its limited local factors such as residential properties; lifestyle services; and entertainment. Thus, the Cyberjaya location is less favourable to attract knowledge workers to live there. Two of the interviewees gave interesting view on the subject of location:

> *"There is not much we could do at Cyberjaya even though it is improving. People still like Kuala Lumpur rather than Cyberjaya and its surrounding" (Fin2).*
>
> *"This concept is not working for Malaysia. Cyberjaya is far from city life and a working vision. The vision of the concept was adapted from the developed countries to developing countries. There are some limitations for this model which is the distance factor and the vision is not quite here yet" (Uni1).*

Further, the population of Cyberjaya during the day is around 54,000 but the number dwindles to 10,000 at night. Among those left are many students and a small number of local residents. The population issue in Cyberjaya is associated with the lack of living accommodation or residential properties, lifestyle entertainment and services, and local public amenities. Cyberjaya was planned township surrounding with many international technology companies such as IBM, DHL, Dell, Shell and HSBC. Based on researcher observation, most of these technology workers commute to Cyberjaya via their own car, sharing cars with colleagues or using the limited bus services. There is no train service to Cyberjaya but it shares a train station, the Putrajaya Sentral, with its neighbouring city of Putrajaya which is about 15km away. There are feeder buses plying the routes between the two cities. The limited transportation services in this area have created negative perceptions on location factors for Cyberjaya.

Despite the influence of location and local factors, local technology production and technology usage of firms in the cluster was considered as important. A majority of interviewee's business operations involves high technology equipment and appliances. Technology clusters such as Silicon Valley, Cambridge, Shi-Zhuan (Taiwan) and Helsinki (Finland) developed and used their own technology which is rather cheaper due to their heavy investment in research and development. In response to such comparison, interviewee from industry (Ind6) indicated that:

> *"I don't think we achieved (the desired) cluster status as we are still trying to improve our capability. We still requires outside technology to help us. There are more choices outside rather than locally, and they are good prices as well" (Ind6).*

It can be seen that there is still dependency on outside technology compared to local or home grown technology.

Three respondents reported that the MSC project has an impact towards achieving technology cluster status. The impact reflects the growth of companies operating within the area while benefiting the business environment. However, interviewees were concern about the continuous support needed for this cluster to succeed. Interestingly, interviewees from the public sector viewed the MSC as a success, which is expected, but to have similar views between interviewees (Uni4) was quite interesting.

> *"MSC is driving us to high technology cluster status. MSC do contribute certain level to economy but there is still room for improvement" (Gov2).*

> *"MSC project has achieved some targets and its respond is very good. There are few companies success in the ICT areas because we gives them good environment. This is one of government approach to locate companies in MSC and now it is successful" (Gov4).*

> *"I would say it has an impact on the country already. We are seeing expansion in IT usage across the whole nation. Even though it is a little bit slow but it is moving. MSC has created impetus to move the initiative further" (Uni4).*

In summary, Figure 7.3 illustrates the factors found to influence the technology cluster status based on interviewees' opinions.

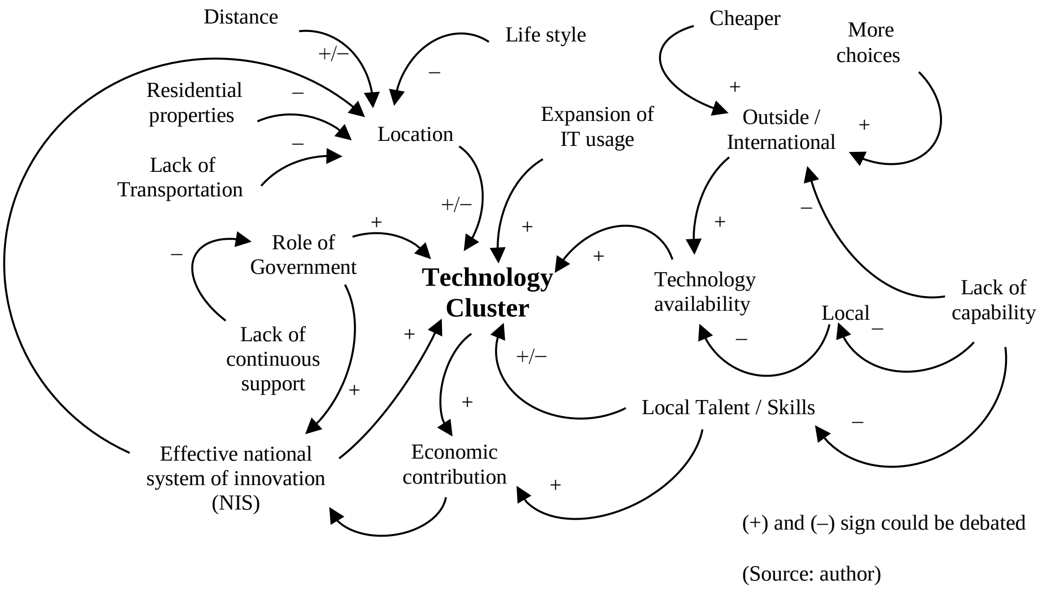


Figure 7.3: Influences on technology cluster status of the MSC

7.3.2 Technology Availability and Position

The availability of technology was considered as one of the important factors identified to support firm formation (Table 6.5). The question here remains whether that technology is acquired locally or internationally and if it (the technology) were locally acquired, has it achieved world leading technology position as identified in the MSC objective? Thus, this qualitative data provides more detail and explanation of the availability of technology uses and the position of local technology compared to technology sourced outside. A majority of interviewee indicated that they heavily depend on outside technology and emphasised that there has been no leading technology produced locally to go on to achieve international success. This is a major obstacle for the MSC project and needs to be addressed before advancement of the cluster can be confirmed. The dependency on outside technology is due to more choices and lower cost compared to locally develop alternatives (if any). One of the factors cited by the interviewees for the reliance on foreign technology is the lack of confidence in locally developed technology. This is typified by the statements from the following two interviewees:

> *"I'm still using foreign technology; local technology is only for some small projects which is not core banking system. Again, it's the confidence level, support etc. ..." (Fin1).*
>
> *"Currently we are not (using local technology) because we still depend on outside technology. There is so much choice outside there with a good price. I think it'll be expensive to buy local technology compare to outside technology" (Fin2).*

This raises the issue of confidence and perception of local technology. According to Ind2, poor commercialisation is said to be a reason of failure of the technology position in Malaysia and international markets, even though some has succeed. This failure is also associated with a lack of: (1) commitment; and (2) continuous support during the commercialisation and innovation process. Competition from global technology producers as they expand their markets heightens the challenge for local companies to be competitive in the technology marketplace. This view is echoed by the concern from Ind5 on the capability of local technology companies to compete in a globally competitive market:

> *"If you defined by leading, I don't think so. There are good and innovative ideas, but where it fails is at the commercialisation stage. Some have been able to achieve local success and some in global success. There is no sustainability. We are good in some areas but the continuity and sustainability we don't have. The follow-up we don't have" (Ind2).*
>
> *"Some might argue that this has been achieved. But I for one do not agree with this notion. If you look at the number of local technology companies emerging from Cyberjaya, you'd be hard press to say that any of them are world leading. We do not have the likes of Huawei, ZTE etc. I feel that a lot more can be done and that the current crop of MSC status companies are relatively small and by small I mean their size and turnover to be nowhere near what is classed as world leading" (Ind5).*

Nevertheless, the interviewees agreed the MSC project has influenced innovation and business expansion in Malaysia, due to the attractive investment incentives which have brought international technological companies to in Malaysia. However, this does not help develop local technology, and can be regarded as working to the detriment of local technology companies. For example, Cyberjaya has become an important outsource data centre, providing services for companies such as HSBC and the NTT Corporation. Relocation of these big organisations has influence other international companies to invest in Cyberjaya mainly due to the attractive local incentives such as tax rebates and lower cost. The interview further highlighted this issue, particularly their concern about the lack of local skills, ineffective technology transfer process and gaps in the commercialisation ecosystem. The lack of local provision for this area of development creates problems for the policy makers. Int4 concerns best reflect this problem:

> *"I think they have achieved quite good things. But, in Malaysia, people look us as an outsource centre with cheaper human capital. They outsource services centres and data centres in Malaysia because it is cheaper. Plus there are incentives here" (Int4).*

This issue was further highlighted by Ind6:

> *"To some extent, yes, but not at the world class level. We need more local skills and talent for this. But this project has improved Malaysia's innovation capability. Now we have a lot of government projects trying to influence and encourage people from a young age, especially at school level, to take part in innovation & creativity competitions. MOSTI is working hard to move Malaysian forward" (Ind6).*

The points raised here are relevant as they refer to the government initiative to encourage innovative capability of local firms. The infrastructures exist, but the MSC now requires the drive and push by local firms to take full advantage of these initiatives and infrastructure.

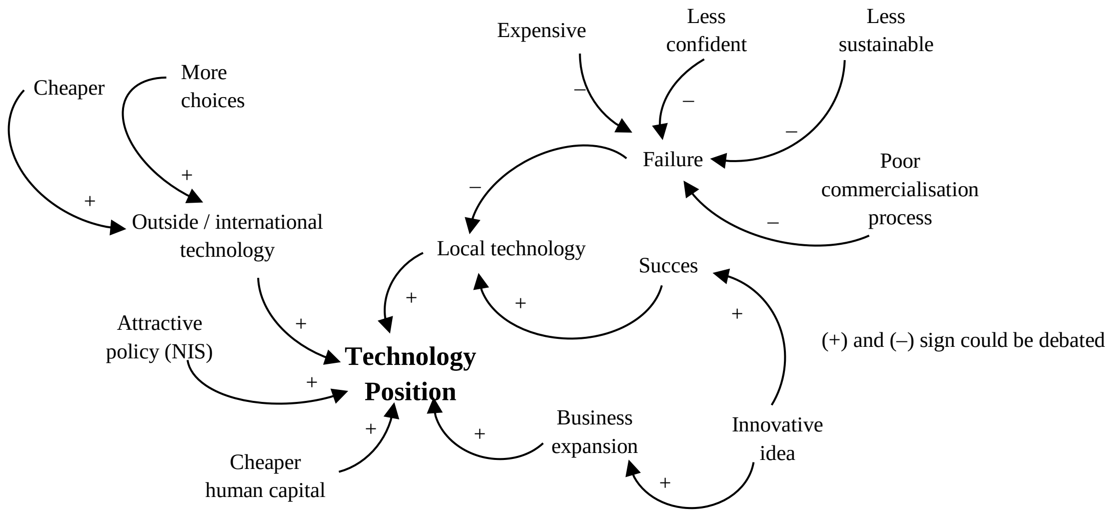


Figure 7.4: Influences on technology position of MSC (Source: author)

7.3.3 Differentiating MSC with other Cluster

One of the research objectives is to establish what makes the MSC cluster in any way different from other (successful) clusters; i.e. where are the gaps? The respondents were asked their opinion on the differentiating factors between the MSC and other clusters such as Silicon Valley (US), Sophia-Antropolis (France) and Cambridge (UK). A majority of the respondents acknowledged that the government's policy and support is attracting more technology FDI to Malaysia.

> *"I feel that the MSC is different in the sense of what it set out to do and also in what it tries to achieve. We are talking about not a regional initiative but that of a nation. While the idea and concept is unique and exciting, I feel that the implementation has been a let-down. Another point worth noting is that the other clusters you mentioned developed over time whereas the MSC is designed and developed almost instantaneously. In that sense alone we should not be surprise that it is a different animal altogether compared to the rest you mentioned" (Ind5).*

> *"The government policy is in favour for FDI to invest in Malaysia" (Ind6).*

> *"The government policy is in favour for investor to come and invest here. As you can see we have a lot of Japanese and Chinese investor as well as American investor" (Uni3).*

> *"The policy of the investment is very convenient. Also we have a very transparent, corporate governance practice and the government is open to*

> *others. If compared to China, India and Vietnam, we are still more favourable in terms of investment policy. We are looking more on high tech industry and we regularly do not give priority to labour intensive industry. But at the same time we also encourage the less labour intensive as we have those resources" (Gov4).*

The attractive policy setting and incentives for international investors, including 5 years investment tax allowance, freedom of ownership; and unrestricted employment of local and foreign knowledge workers, are designed to encourage FDI to locate in dedicated areas, including Cyberjaya. One interviewee from industry (Ind1) offered that the attractive policy was influenced by the government's vision to become a develop nation by 2020.

> "*Government I suppose and this is the only one that makes Malaysia different. This is part of the whole agenda of to become developed nation in 2020" (Ind1).*

This view was also supported by other interviewees notably *Ind5, Ind6* and *Uni3* as presented earlier in this section. They agreed that the role of government and its 2020's aims have influenced the policy setting in the MSC cluster region.

Issues that arise from policies for attracting FDI are the relevance to evolving the cluster to be more research and development (R&D) driven and to develop local technology. The survey conducted prior to these interviews found that 69.3% of respondents were satisfied with the cost of labour in their industry. This was cited by a majority of the interviewees who admitted that lower labour cost compared to neighbouring country such as Singapore, is an advantage of the MSC. One interviewee succinctly summarised this as:

> *"Malaysian market is still small … we have not internationalise ourselves likes others …We are not like Silicon Valley or Bangalore but we can be in future. Our GDP is not big enough, like Singapore is because in financial and high tech*

people come here because technology also and labour intensive because we are cheaper here" (Fin2).

The development of local infrastructure by the government is a key feature, since many clusters rely on their infrastructure to conduct their economic activities and operations. The development of the MSC required the government to invest heavily in hard and soft infrastructures such as telecommunication, road and transport, universities, research institutions, incubators and science parks for knowledge and technology transfer centres. A large investment was made to the area surrounding Cyberjaya after it was earmarked as 'cyber city' and chosen at the epicentre for the MSC cluster. High value infrastructure was put in place in Cyberjaya including very high bandwidth fibre optic network cabling; a planned town and residential area; and a knowledge centre housing Malaysia's then first private research university – the Multimedia University. However, it was found from the survey and the analyses of the interviews that infrastructure developments alone are not enough to engineer a vibrant cluster within the MSC such as those of Silicon Valley and Cambridge.

Based on World Competitiveness Index 2011-2012, Malaysia was ranked 26th for infrastructure. Other Asian countries that achieved a better ranking are Hong Kong (1st); Singapore (2nd); Japan (15th); and Taiwan (20th). These countries also have far superior local technology development compared to Malaysia. The development of infrastructure is necessary but a shift in government strategy towards the development of 'soft skills' and soft assets are required in order to facilitate the development of local technology capability. This is a view voiced by Gov1:

"MSC was developed from the ground up. How we are different is the support from government – continuous support from the government and MDeC is there to facilitate and drive the development, meet the KPI (Key Performance Index) set by government and what is required after that is the essential part which is

> *what the university can bring to complete the package. We are more geared towards infrastructure development. We now need to look into taking a more holistic view of the situation and so on" (Gov1).*

The discussion in Section 4.3 identified political stability as one of Malaysia's key strengths. The coalition party, the National Front, has governed the country for the past 45 years and in that time has transformed Malaysia from agriculture based economy to industry based economy. The focus now is on becoming a knowledge driven economy. The political stability has influence the economy to move resiliently out of the Asian Financial Crisis and Global Recession in 1997 and 2007 respectively. This is supported by the Global Competitive Report 2011-2012 (World Economic Forum, 2011) which states that government instability and/or coups were major reasons for not conducting business in some countries. One interviewee states this as a reason behind continued investment in the country by foreign businesses:

> *"Malaysia can be said to be advanced compared to other Asian countries. Our country is special in the government's policies that are attracting investors to come over here. The policy is meant to create employment in the country. People outsource here because they get infrastructure and even incentives like tax break. Our political stability makes them feel safe to do business" (Int3).*

7.3.4 Contributions of the MSC

Respondents were asked their opinion in relation to the contributions of the MSC to them. A majority of the respondents agreed that the MSC has influenced innovation awareness among the general public, particularly at school level. To further increase awareness and importance of innovation, the Malaysian Foundation of Innovation was established in October 2008. Its main objectives is to nurture, promote and conduct various educational creative skills and awareness's programmes in the field of science and technology across nation in academic, industry and society. The priority is to enhance the appreciation of science and technology among children. Five years from its inception has seen a notable shift in public awareness of the value of technology innovations, and it is best summarised through the view of one of the interviewees:

> *"Definitely, there is a lot of awareness of IT, technology improvement even the banking system is improving as well and it is cost effective" (Uni3).*

In contrast to the above view, Int3 support the notion that the public is benefiting from the government investment:

> *"In terms of awareness to the Malaysian public it is yes but other than that unfortunately not" (Int3).*

The MSC has contributed towards the development of Cyberjaya and its surrounding area, particularly the improvement in infrastructure such as new road network; business complex and buildings; incubators; residential area and faster fibre optic network connection, and Cyberjaya is viewed as a model for planned-urban development for other regional development such as the new southern development corridor, Iskandar Malaysia.

> *"Yes it is a good step and initiative. At least this is proper infrastructure development between government and industry and university as well. This is an eye-opener for future development projects in the country" (Uni2).*

However, there is also concern from interviewees regarding the quality and cost of the infrastructure of the MSC. This concern has influence other investors to move to other countries in pursuit of lower cheaper costs.

> *"Off course we have got to start somewhere. I mean we have got to be serious in our improvement. At least Malaysia brings international companies resulting in technology transfer. It can be said that location is borderless and our infrastructures are still expensive compared to others as we mainly import technology from others" (Fin1).*

As mentioned above, the MSC project has improved public awareness of importance of technology industry towards economic development in Malaysia. It promotes the national vision to become a knowledge driven economy. This requires the country to produce technology-based skills and actively involved in knowledge and technology transfer activities, as acknowledged by interviewee Fin2.

> *"Yes that is what the government has been doing to ensure investors come to Malaysia so we can benefits from the technology transfer. Again, we should thankful to Tun Mahathir. Without this project, Malaysia is probably still behind other country. The cutting edge technology involved in this project promote the creative industry in Malaysia as well as helps increase the talent pool of local skills" (Fin2).*

The interviewees assert that there has been an increase in domestic as well as foreign direct investment in Malaysia. An interviewee from MITI explained that the domestic investment is steadily increasing and confirmed that MITI is committed to further focus efforts on domestic investment development. The physical result of both can be seen in the increased number of offices occupied in the MSC with a mixture of local and international companies. A majority of those are involved in businesses related to ICT and multimedia activities, while most biotechnology companies tend to locate in areas near UPM-MTDC Park and Technology Park Malaysia (TPM).

> *"I don't have the figure at the moment but I know it contributes billions in economic growth……. Currently there is 40% domestic and 60% foreign direct investment but now we are trying to get more domestic investment. For FDI everyone goes to China and India and we also competing to get it as well. We*

> *also have to give focus to domestic investment. That's why the collaboration issue you talk about and MITI is tried to get all the big companies to expand their investment here. This is also part of our job to bring investment from domestic and foreign investment" (Gov4).*

The area of the MSC and Cyberjaya is regarded as a model of an IT based "Intelligent City" by MDeC, the agency overseeing the implementation of the project. The area is equipped for biotechnology, ICT and multimedia companies, and multinationals who wishes to use the facilities to operate their manufacturing and service plants. Thus, the availability of technology infrastructure such as communication, data centres, office centres, electricity supply and backup are considered vital to attract not only local but also international investors. The communication system uses fibre optic cabling to enable super-fast broadband connections. This stimulated the interest of multinationals such as Shell, IBM, Dell, NTT and BMW who located their resource and data centres in Cyberjaya. Interviewees agreed that the development of the MSC has improved areas around Cyberjaya. However, there still is an issue with the underdevelopment of social facilities and services which obstruct its progress. Respondents from the industry argued that the unattractiveness of Cyberjaya as a central location of MSC do not support the formation of a functioning society with very limited attention to the soft details such as housing, shops, health care centre and places to eat i.e. café and restaurants. One interviewee put this across as:

> *"No. I wouldn't invest in any MSC companies especially after the dotcom bust. It makes the world so much smaller and flatter. Before everyone want to become MSC Status companies due to the incentives then people realise that there is nothing special about the MSC anymore. It doesn't make any different to how change occurs in the country to become developed nation" (Ind1).*

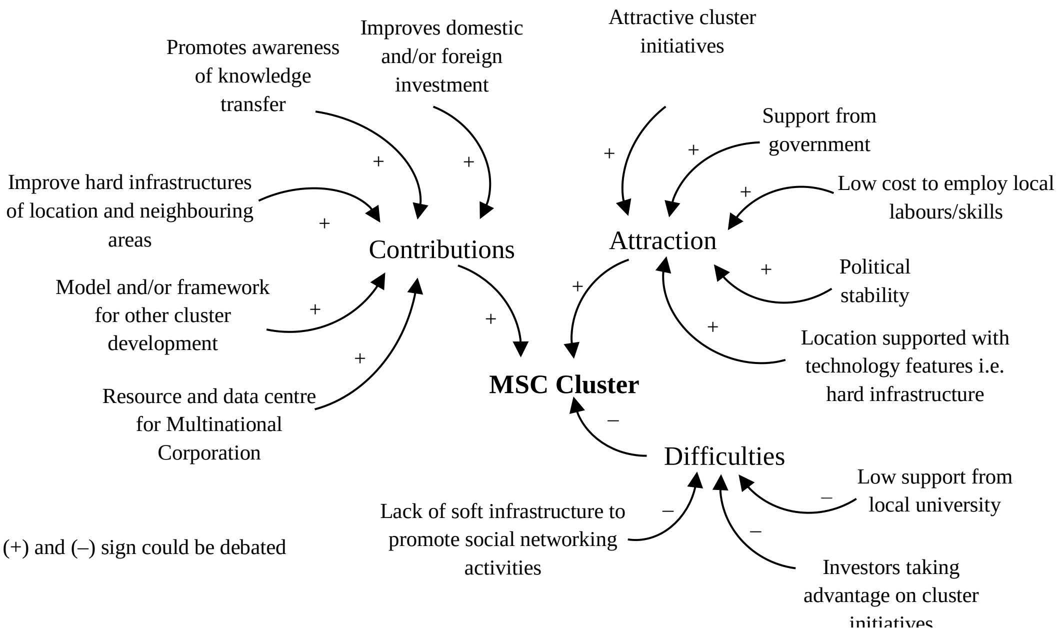


Figure 7.5 Influences on contributions, advantages and limitations of MSC Cluster (Source: author)

7.4 ACTORS AND ROLES IN THE MSC CLUSTER DEVELOPMENT

The success of high technology clusters such as Silicon Valley is associated not only with strong linkages amongst its system actors; active involvement of venture capitalist and advantage of geographical concentration but also through the complex roles played by the system actors within the cluster. Dynamic relationships between the local firms (industry); university and government allow clusters to evolve and develop in a unique way (culture). On the development of the MSC cluster, interviewees indicated that the roles played by government and industry contribute significantly to cluster development. Overall, 9 interviewees were in agreement with the notion that both government and industry are equally important in the development of the cluster. However, the perceived contribution towards the development of MSC from the university was minimal (Table 7.1).

Overall, the roles of actors or stakeholders in the cluster were identified in the analyses as emerging issues. Each stakeholder has a particular perspective on the others and it was found that the role of university was perceived as the lesser partner and contributor in the cluster development. The analyses also discovered that the role of government is seen as the dominant contributor in the development of cluster. This reinforces the findings from the quantitative data survey (Table 6.6).

Contributors in MSC cluster development	**Count**
Government	8
Government & Industry	9
Government & Intermediaries	1
Industry	2
University, Industry & Government	1
University & Industry	0
University	0
Total	**21**

Table 7.2: Relative major contributors in the MSC cluster development viewed from interview respondents

7.4.1 The role of university

The interview respondents (Fin1, Ind5 and Ind6) admitted that even though the traditional view of the university as a centre for learning and teaching in higher education producing graduates; and developing knowledge and research for social and economic development within the cluster are still valid, they should also be looking at the holistic development of graduates who are 'well rounded' and are able to fit in with the industry requirements. This view is shared between three of the interviewees as follows:

> *"University is currently producing without looking into quality and just shout license for everybody to go to university. However there are plus and minus in these but one thing they want is for everybody to be educated. It is a good thing*

but the quality need to be further improve once the competition coming and each university got to improve the services " (Fin1).

"The universities on the other hands are too focused on teaching and churning out graduates at an alarming rate that they are now seen as one big factory taking in raw materials which are the students and turning them into products that exit at the end of their course. A lot and I mean a lot of these students are ill equipped to work let alone be let loose into the real world. Half of the time they don't even know the basis of what they studied. I feel that university need to be more stringent in their admission and be more selective and rigorous in their method of teaching as not everyone is equipped with the capacity to go through the full gamut of tertiary education. Again I feel that the government should play a bigger role here in advocating a parallel system that takes away all of these non-academic inclined students and put them through a more skills based learning process like in the UK for example. The apprentice system works very well in most European countries" (Ind5).

"We should have close relationship with university. University is not really active to collaborate. Sometimes the university doing research for the sake of research publication but not for the result and value added that can be commercialised. University is more concern to produce big number of graduate and not looking after the quality and also the result of research is not value enough to make money. I said this because we have experienced working with some local graduates here and some of them we are quite happy but majority are less confidence and need a lot of guidance. The project that we collaborate at the end was well-worthy but we certainly learn our lesson when handling projects with university" (Ind6).

According to the interviewees (Ind1 and Ind3), the role of a university is seen as a source of supply of talent and manpower for their organisations. This view is also echoed by the university through Uni4. Collaboration activities such as research projects with universities have given industry partners an opportunity to identify and select talented student in-situ and early (prior to graduation). This helps lower the operation cost for staffing and recruitment processes. However, the issue on quality of the graduates remains a significant concern for industry, as indicated below:

"It is important they (university) help us in research to some extent and we keep eyes on good graduates (coming out of the universities)" (Ind1).

"Only in terms of manpower and I don't think local companies are actively doing research or we can get good assistance from the university, just for the graduates" (Ind3).

"Yes, we should maintain close relationship with the university as they are the talent and skill provider, without them how can we have great entrepreneurs and researchers" (Int3).

"Off course we are a source of human capital and knowledge to industry. The only difference is that we have so many gaps" (Uni4).

Further views from interviewees concerned the significance of the university contribution in the cluster. It was found that universities contributed less to the development of the cluster based on a lack of commitment and contribution on relevant research. This has left doubts about the capability or capacity of universities to offer services as a centre for research to industry. The interviewees felt that the research valued by the university is less marketable and less focus on the technologies of current and future use to local industry. Adding to this, a respondent from government (Gov3) indicated that there are now initiatives to improve the quality of research and linkages with industry; certain universities have been awarded Research University status. This status is aims to give the university preferential status in receiving research funding and given more autonomy of from government control. Three interviewees (Int1, Ind5 and Gov3) stated their opinion of the universities role in the MSC as follows:

"It's important they help us in research to some extend…Relationship with university is good either for technology testing or research, and testing our idea" (Int1).

"The universities have been slow in providing any significant contribution. I feel that the focus of the universities have been on teaching alone and not enough is being done on the R&D side of things. This is where Malaysia is lacking at the moment. Other clusters around the world has been developed mainly due to their proximity to academia and that some of the successful companies has been spin-offs from university research though some companies has been developed

by university drop outs. But the central theme is that these companies are located within a cluster that has close proximity to universities" (Ind5).

"Recently government have awarded certain universities as Research University to strengthen the R&D between university and industry. They are given special program to work with industry and grant. These five universities so far have doing good work with industry in terms of research. I think this is the right approach" (Gov3).

As mentioned by interviewee Gov3 on research university status, the university is motivated to perform research and business collaboration with industry and other universities (local and abroad). Furthermore, respondents from university admitted that they have a number of program and initiatives to encourage collaboration such as student exchange program, scholarship, internship programs and establishing research and business centres specifically to enable linkages with industry. Universities are now attempting to demonstrate their committed of resources to act as collaborators for research and business in Malaysia.

"We have programs which relate to other universities where we give scholarships to our local students to work in technological areas at overseas universities. We have a lot of work with USM, UiTM and many more" (Uni3).

"Most universities have started to form industrial department relations which are very important initiatives currently for all local universities. We (UiTM) has restructured; and recently formed the RIBU (Research and Innovation Business Unit) to cultivate, nurture and reorganising ourselves to be more effective with the industry" (Uni4).

"We are collaborating with USM, University of Pahang and University of Terengganu. What we do is that we see what sort of research that they have done. We evaluate it first and see if the research has a commercial value. Then we see what we can do to help this research and try to bring it to market. I think that is the better way to do it" (Int4).

The analyses also found that the interviewees see universities as a source of funding. Interviewee Int3 suggests that the industry in particular small technology firms should collaborate with university as there are opportunities available in the form of research funding.

> *"Industry should take the advantage of working with university as they have a lot of funding for research and this could help young companies in particular the small high technology firm"(Int3).*

Interviewee Gov3 felt it was the role of government to develop science and technology capability and pointed out that the Malaysian government is trying to build local expert in technology related areas. Interviewee Gov3 further explained that there are R&D grants given to universities for collaborative work with the industry in order to achieve the target of creating local experts in technology.

> *"It is important for our country. Our industries don't have any expertise and they buy technology from overseas. To create indigenous technology, we normally want them to work and collaborate with university. In our R&D grant given to university and industry, we strongly encourage industry to work with university" (Gov3).*

The universities are also viewed by the interviewees as knowledge sharing providers. This role requires close relationship and collaboration between university and industry which helps create more opportunity for the industry to access knowledge and source talents. Interviewee Ind4 suggests universities should collaborate with the industry to create more internship training programme for students in preparation for their graduation:

> *"On that part you have to think twice. First you can access of knowledge from university. Second you can get the work force or talents, and we can share knowledge for the industry. To me it's important as the relationship helps for university and industry as well, win-win situation. I urged university to do more collaborative work with industry as this will help their graduates and helps industry as well. There should be more internship or practical training for local*

graduates with industry. At current situation, we received low participation from university even though there are other universities are moving to this direction" (Ind4).

Moreover, interviewee Gov1 highlighted that universities should be seen by industry as problem-solvers, who are capable to perform marketable and value-added research. This role as problem-solvers will not only benefit the university but also industry by providing advice and expertise in knowledge; and/or technical support and project management. Effectively, these are relatively easy to deliver, low cost and commitment, knowledge transfer activities.

"Industry should see university as problem solvers you know, and university should show them that they are able to carry-out research and be more competitive" (Gov1).

The survey analyses found that that industry is generally dependent on government. They value highly the relationships with government much more than other partners notwithstanding their customers.

"University is part of initiative to improve and support the direction from the government. The impact is important but local university has less active relationship with others" (Fin2).

However, the analyses of the interviews found that the interviewees admitting that they (universities) are too dependent on government. This is particularly related to the requirement that they report to a university council led by the Ministry of Higher Education.

"We are still depends on government even though each university has the authority in their strategic plan and decisions but we have university council that report to MOHE (Ministry of Higher Educations)...Sometimes the policy is confusing and we are not sure what direction that government want us to do. You can notice this if you look at the Malaysian 5 Years Economic Plan, the RMK-10th (Rancangan Malaysia ke-10) especially" (Uni3).

This shows that university (at least in the Malaysian context) also act as an agent for the government. Furthermore, most universities in Malaysia receive financial support from the government apart from private university.

There is also evidence from the interviews that part of the perceived role of a university in a cluster is the generation of technology spin-offs, new ventures and entrepreneur creation. In the entrepreneurial university concept, healthy linkages among triple-helix actors influenced the university in capitalising its knowledge. These linkages involve economic activities and result in the creation of new start-ups and spin-off companies. However, interviewee Int3 stated that there is still a heavy dependency on intermediaries and government to support commercialisation activities:

> *"I don't see we have created a lot of spin off except for some old university like UHSAINS of USM, UM and UPM, where they are actively involved in research collaboration with industry" (Int3).*

Finally, interviewees identified the role of university as a consultant to government and industry. The role of consultant to government is more related to policy setting and advisory capacity. With regards to the acting as consultant to the industry, it involves providing expert advice and mentoring on related research area.

> *"I think now a lot of curriculum designed at university includes involvement of industry and more courses designed to suit the industry need. Collaboration and participating in consultative forum are very important especially when the government need to develop new growth areas, they will not decide on their own. They will go for corporate studies and they will include university and industry to come out with focus area. We want everybody to give support and contribute into certain areas such as capacity of people, funding and investment. We don't want to spread our resources that came from government only but also want the industry and academia to work together as well" (Gov1).*

> *"If you look at our website we have collaborative work with international companies such as IBM, Oracle and Microsoft. For local companies we work with Proton and MIMOS. We also offer consulting services as part of our collaborative work with industry" (Uni3).*

"In Malaysian context, this has not really happen in bigger scale and a lot of initiatives are more on advisory and consultancy, not really collaboration as business partner yet" (Int1).

7.4.2 The role of industry

Interviewee Fin1 explained that the role of industry in a cluster is to acquire and share knowledge and resources within their network of association since they have similar and common interest of research needs for their activities. This underlines industry's disinterest in sharing their knowledge and resource with universities.

"We have no problem with industry. We have association where we get together and share resources. We also have our own research. The money spend will use on the really important things" (Fin1).

Similar roles played by industry and university were identified by interviewees; that is, acting as advisor to government (Section 7.4.1). Government seeks advice from industry in consultation work for policy setting and implementation process. Interviewee Ind1 explained that they have close relationship with other companies within the same industry gives them an opportunity to seek and hire skills from local and international labour.

"The impact is quite significant to have relationship with the industry. I think everybody in our industry find it useful. This can help in hiring foreign trained graduates because they have a wider exposure and they are able to understand our needs compare to local ones" (Ind1).

University interviewees also viewed industry links as strategic knowledge and technology transfer mechanisms. This was identified by Uni4 who mentioned that knowledge transfer activities such as internship programmes helped universities and graduates learn new skills and experiences with the introduction of latest technology by the industry. This helps to create business opportunity for both university and industry through collaborative project and sharing of IP together.

> *"The advantage is that we can get more advance technology. We are (the private company) and research institution can have the first information with them and also the first look of the latest technology being developed. If we collaborate and we have the edge of IP and so on, it is good for the company as we can have more business opportunity. We can explore more business opportunity" (Ind4).*

> *"The knowledge transfer program is more towards internship program. For example students go to industry as catalyst where we provide indirect work to industry to nurture whatever expertise we develop for industry. Everything is steering into that direction and hopefully in 5 years' time we could see more of results. We are trying to bring industry together with exhibitors from university that have business matching that can push product forward" (Uni4).*

The industry viewed competition in cluster as a motivator for having close relationship and social network contacts. Interview respondents from technology industry's believed that role of industry in a cluster could inspire companies to work harder in order to survive in the same market and industry.

> *"The industry need new technology as cost is very important for industry to sustain. We have no problem working with other company as it motivates and increases our competition level, so you want to work harder than your counterpart. Social contact is important in the business environment" (Ind6).*

The role of the industry is also seen as a training provider for local skills particularly fresh graduates in areas of technical and soft skills such as communication as described by interviewee Int1-A. Furthermore, respondents claimed that the soft skills require time to nurture and suggests university include elements of soft skills development within their learning and teaching activities.

> *"The bigger challenge is to solve the soft skills issues as Int1-B mentioned earlier on. These problems are attributes that arises from the industry apart from the technical skills. Some industries are willing to contribute training in technical and soft skills but the soft skills components it takes long time to nurture" (Int1-A).*

Above all, the most important role of industry in cluster is as an engine of growth, a view shared by the interviewees

> *"Government is the main body that initiate this strategy and firms are the industry, and involvement from industry will make the industry to happen" (Fin2).*
>
> *"We look this as really important and it is part of our objectives to have close relationship with industry. Without industry our industrial initiative will not work" (Uni3).*
>
> *"I think industry is the main players. Government always said industry as the engine of growth and government will support and facilitate the industry. That role is clear and the government is clear in that because we will not actually play with the industry and we should let the industry become the engine of growth and government will facilitate in terms of regulations and incentives" (Gov1).*

However, this raises the importance of having close relationships with industry and that failure to do so could affect the industrial development.

7.4.3 The role of government

Other than as a source of funding, other common roles played by government viewed by the interviewees are: (1) the policy planner and setting; (2) regulator. The interviewees explained that having close relationships with government in the MSC cluster is important for the industry and particularly for technology industry to communicate and identify their concern on difficulties and challenges that the government could be influential to resolve. This could help the government in forming necessary policies to include incentives and programmes to address fundamental issues faced by the wider industry. On the other hand, it is also government responsibility to ensure the industry and university are making progress for the development and growth of nation's economy.

"Government role as regulator by giving support and incentives to businesses is very important. That relationship is very important because they can start businesses anytime" (Ind1).

"My personal view it is good we have close relationship with government. The impact is we can have easy access and we can have first in-hand information from the important people" (Ind5).

"It's important as we need to collaborate with government but it still not enough. Obviously government are the one that note the policy and procedures and we have to follow. If we are regularly having contact with them, they can understand us better and know what problem that we are facing. So far, government are very supportive to us" (Ind6).

Interviewees also claimed that the role of government is to connect the industry and university with the potential and appropriate market with the support role played by intermediaries such as MATRADE, MIDA, SME Corporation and MDEC. Failure of some companies in industry is said to be due to the failure to connect with the relevant government agencies. These agencies are entrusted by the Malaysian government to help in realise Malaysian mission of becoming a develop nation in 2020.

"Most local firms are afraid to do so and they are still need government support to do that. MATRADE, MIDA, SME Corporation and even MDEC have a lot of programme that helps our local firms for this. Yes, some firms are not experience on this but with these government agencies should not be a problem. As I said earlier, if we encourage our people from the early age, they will confidence to market their product even no experience and the role of government agencies should fit the gap. Most of company failure is because they don't seek help from these agencies and at the same time their products doesn't have sound of marketable value" (Fin2).

"For our industry to go to market we realised that there are a lot of barrier especially in global market you know because global market look at certification. Certifications are very expensive and we called that non-tariff barrier. In realising that what the government is fostering to do to set-up 'shed centre' where government fund some certification for example in term of security software, common criteria and some sort of certification for quality. We realise we need to subsidies the industry for obtain certification so that they can be competitive in the market. So this is one ways we helping them with this kind of facilities where they can come and being certified and they can sell it. This is government role" (Gov1).

> *"To get everyone to agree and sit together is the most challenges. Sometimes the higher intervention is needed to solve this problem and that's why government role is needed." (Gov2).*

Furthermore, interviewees viewed the role of government in the MSC cluster as the main enabler of the economic environment suited to the growth and development of industry and university. The interviewee from government described the MSC cluster project as an example of the roles played by government in providing economic environment such as infrastructure, housing and business premises and transportation which among of its national priorities.

> *"The government role is to provide the environment. Currently the environment or ecosystem is already there and it is up to private sector to use the environment and come-out with necessary project. If everything (supports) come from government then it will not be possible" (Gov4).*

> *"This is important relationship as we are not developed country yet so the role of government is important. The government responsibilities are many and most of it to nurture economic growth and social stability in the country. The development of national policy is crucial as it depends on the country's priority. So, the amount of budget or funding provides by the government is align with national priorities. Thus having close relationship with the government is important for the reason that I've said earlier on" (Int3).*

7.4.4 The role of intermediaries

Smedlund (2005) claims that the role of an intermediary in regional development needs to go beyond knowledge transfer and become adapted to the specific demands of the local priorities. Smedlund (2005) also claims that the regional level is the most crucial role since it connects the national and local level together with a mutual strategic formation, visioning process and support for the triple helix actors of university, industry and government. Interviewees were asked their views on the role of intermediaries in the development of the MSC cluster. The interview analyses suggest that intermediaries play an important role in accessing funding and/or research grant for university and particularly industry. Interviewee Int4 said that their organisation has better access to help for industry to fund research and commercialisation. However, an interviewee from government (Gov1) complains that there are some intermediaries (such as MIDA, MATRADE and SME Corporation) that work for government have overlapping roles and responsibilities in supporting both university and particularly industry. This has created confusion to both university and industry on the appropriate support process and are generally unaware of the intermediary's role in potentially facilitating accessing to project funding.

Despite the confusion, interview respondents still indicate that they consider intermediary roles as consultants for activities of facilitating, motivating, marketing and commercialising, project management and linkages with university, industry and government. These bridging activities of consultants (Bessant and Rush, 1995) are to primarily to support industry and make them aware of current developments; interview respondents (Ind1, Gov2 and Int1-A).

> *"The government obviously as they are facilitators, initiators, promoters and regulators for continuity of relationship. For example MIDA they have done a lot of dialogue between the university, industry and government to discuss of current issues" (Ind1).*

> *"I believe its combinations, and collaborative effort both from the government as well as industry; and MDeC being as one stop agency or intermediaries to ensure whatever the private sector agenda or industry agenda is managed and supported by the government. We are basically like project management or project manager for the government" (Int1-A).*

> *"The role of agencies such as MDeC and MATRADE to integrate between university and industry is important in my point of view. Their influence can bring university and industry working together and share knowledge and cost especially, then we can achieve a marketable end product" (Gov2).*

Other roles of intermediary organisations are acting as an agent on behalf of the government. This role is transparent with agencies cited by interview respondents such as MATRADE, MIDA, SME Corporation and MDEC being clearly associated with selected Malaysian government's ministries i.e. MOSTI and MITI.

Interviewee Fin2 claimed that failure of some Malaysian companies is due to their failure to contact agencies and ask for support.

> *"Most local firms are afraid to do so and they are still need government support to do that. MATRADE, MIDA, SME Corporation and even MDEC have a lot of programme that helps our local firms for this. Yes, some firms are not experience on this but with these government agencies should not be a problem. As I said earlier, if we encourage our people from the early age, they will confidence to market their product even no experience and the role of government agencies should fit the gap. Most of the failure company is because they don't seek help from these agencies and at the same time their product doesn't have sound of marketable value" (Fin2).*

Apart from providing support for linkages, the role of intermediaries is also seen as a business intelligence provider and market researcher, particularly for industry, as described by respondent from government.

> *"What MDeC doing is taking industry to market actual where in value of chain they can play. Let's say software in e-solution and there is demand in Korea for example. So they will take the company to Korea to do the pitch and try to get some linkages. We need a lot of business intelligence to do this. Companies like MATRADE and MDeC have to do a lot of business intelligence and they have to know the business area. The people in MDEC and MATRADE should have that capacity. May be some restructuring involve for example in MATRADE need to know the business area before they can say Ok we can go here and there. Otherwise they just become two operators which we don't want that. What we want are people who are knowledgeable" (Gov1).*

The interviewees also added that this role is important for the preparation of the actual linkages with prospective clients on commitment, capability and familiarity of the related subject areas which could enhance the investment and business opportunity for the Malaysian companies in local and international market. Suggestion on restructuring of the intermediary management is also mentioned by respondents to improve the effectiveness of their responsibly. Interviewees raised their concern on the effectiveness of the intermediary. There also appear to be some degree of frustration with the role played by intermediaries such as MDEC notably the point put forth by Fin1:

> *"I don't know what MDeC are doing. To me MDeC is more towards collaborative works like bringing in outside people and create incubations but I don't know how successful these incubations are. However, big organisation bought over IT from all over the world" (Fin1).*

Intermediaries are also seen as playing the role of training provider and educator. Interviewee Gov4 mentioned the patent awareness programmes that organised by SME Corporation.

> *"In Malaysia 90% and above establishment is SMEs so they think they don't need patent and this is another issue. That's why we have SME Corporation to develop the SME. They have a lot of programme, not only give assistance of finance and also human resource development, adviser and they come-out with SCORE. SME Corp will give score in terms of Star – they will assist them from 1 start to 4 start. When they at 4 star they can be independent like they don't need help in finance and marketing and other" (Gov4).*

Interviewee, Gov2, explained that some difficulties faced by industry, particularly small companies, are the limitations for acquiring professional certification to enter and compete in the market. The MyProCert programme organised by MDEC is said to have reduced these limitation and increase confidence among local firms to be competitive.

> *"ETP- MyProCert initiative by MDeC with various multinational to certified for local professional. I suggest you go to KDI (Knowledge Management Institute). The all parties try to close the gap. University is trying to change their curriculum" (Gov2).*

> *"We want this to happen (relationship). We have programme from MDeC like industry programme. We are try to put all parties together and try to close the*

> *gap and only the government are stronger to do that. Better late than never and we learnt our lesson and we have improve" (Gov2).*

Finally, interview findings suggest that the role of intermediary is also seen as resource agents, not only for financial assets but also for talents and skills. An interviewee from government mentioned the role of TalentCorp Malaysia, and outlined numerous programs in addressing the Malaysia gap in skilled labour. TalentCorp Malaysia's mission is to attract talented and skilled Malaysians expatriates living abroad to return and work in Malaysia.

> *"Government is really looking this local skills issue very seriously. Government is looking for talent and we have Talent Corporation as an agency to tackle this issue. We have a lot of programmes and it is true that we are lacking of talent. So we are now given the task to work with Talent Corp, MIDA and university to come out with programme" (Gov4).*

A summary of roles played by universities, industry (firms), government and intermediaries is presented in Table 7.3. It can concluded that these are evolving, with the role of universities coming under some pressure from the other actors to improve on their weak collaboration position, while also addressing concerns regarding the quality of the courses offered and the graduates produced. As the main power in the cluster, the government, acting through its agencies and intermediaries, has a role to close the communication gap between the universities and industry, However, it has yet to develop the right agency design and policies; Smedlund's (2005) adaptation to local priorities.

Role of university	Role of government	Role of intermediaries	Role of industry
• Learning and teaching centre • Source of talent • Research and development centre • Collaborators for research and business • Spin-off and entrepreneur producer • Source of funding • Knowledge sharing provider • Problem solvers • Agent to government	• Source of funding • Policy planner and regulators • Connectors to market • Intermediaries • Provides support to industry and university • Provides economics environment	• Access of funding • Facilitator • Project manager • Agent for government • Problem solver • Marketing and commercialising • Training providers and educators • Business intelligent • Resources agent • Knowledge and technology transfer centre	• Sharing knowledge and resources • Corporate social responsibility • Adviser to government and academic council for university • Seeking and hiring skills and talent • Provides knowledge and technology transfer • Motivator for competition • Provides training for local skills • Engine of growth

Table 7.3: Summary views on role of actors in MSC cluster by interviewees respondents (Source: author)

7.5 COLLABORATION IN MSC

As indicated in Section 2.3.1, having close relationship among actors within and beyond a cluster is crucial for the success of the cluster. One of the ways to look at the relationship is through collaboration as an activity to binds the actors together in and across clusters. For this reason, the interviewees were asked on the motives or drivers for them to collaborate and the challenges they face.

7.5.1 Drivers for collaboration

A majority of survey respondents in Section 6.5.2.1 indicated that collaboration gives high impact to the business and social benefits such as increasing social networking contacts and business reputation. The interviewee (Fin2) agreed with this and added that it also improves their social commitment and responsibility with a reason to fulfil customer's needs:

> *"Yes, we have done a lot of collaboration with government and university as well. Again with industry is that we are trying to improve social responsibility in order to meet the need of the customer" (Fin2).*

However the interviewee Gov3 feels that universities are doing less networking with industry. This was said to be due to the pressure on academics to teach and publish research papers, and the way they are assessed for promotion. This has been cited as an obstruction for universities to perform active collaboration activities within the MSC cluster. The government in particular is concern with this development, highlighted by interviewee Gov3, stressing that there is a need to encourage both parties to perform collaborative work together. This involves government through its agencies, organising business and education exhibitions.

> *"Sometimes the university lecturer they have to publish papers. So, you publish or you perish. This is not what we want from the university. In the last 2-3 years we are trying to bring the university and industry together in exhibitions and look at what each of them can offer. The collaboration between these two entities needs to be strengthened" (Gov3).*

The access to sophisticated and expensive University technology or equipment is believed to be another motive for collaboration, as indicated by survey respondents in previous chapter (Section 6.5.2.1). 44.3% of survey respondents indicated it as high impact to the organisations. Interviewees also indicated that due to the low number of research institutions in Malaysia and limited facilities and sophisticated technology or equipment, collaborative partnership is one of the methods to solve these issues; most of the research grant applications received from universities is budgeted to buy research equipment.

> *"Many of new universities in Malaysia they are running the university like business minded and they do not have a lot of facilities to do research. Equipment is very expensive. Unlike UKM, USM and UPM they already established and they have equipment to do research. However new university does not have such facilities and when they apply for grant, we noticed that they have a lot of budget to buy equipment. We are focusing these 5 universities because they have well-known scientist to focus more on research. We don't have a lot of research institute in Malaysia. We are encouraging them to collaborate with the research university. I personally feel we should have a lot of research institute so that the new university can use the facilities and encouraging collaboration and not only focusing this 5 research university." (Gov3).*

Apart from accessing facilities and equipment, another driver for collaboration is for the purpose of research and development. The interviewee feels that in biotechnology industry, collaboration in terms of research and development is essential especially for small companies to take the opportunity with the services and research provides by university. Interviewee Ind5 explained that close relationship with university is important for small companies in technology-based industry as it helps in focusing specific areas of research, benefiting in financial support as well as the usage of facilities and equipment, and expert advice from the university's scientist. Survey analyses conducted in Section 6.5.2.1 also agreed that collaboration related to R&D is important as it help upgrade and increase quality of the research itself with over 75% assigning high impact to the organisation.

> *"In the biotech industry, this is inevitable. You need the close link with the universities and to gain access to their blue sky research. Some of the more notable work has been churned from universities labs. You have to keep up with the work coming out from universities and be ready to back up these researches financially in the hope that they will lead to the next blockbuster drug. I feel that the age of large pharma is numbered and that the way forward is for small boutique biotech companies developing products that target specific disease with the collaboration and linkups with universities"(Ind5).*

Financial support has been recognised as one of critical success determinants in the cluster initiative and cluster development literature. In a funding initiative to promote the MSC cluster, the Malaysian government (Ministry of Science, Technology and Innovation) have allocated four types of research grant namely; ScienceFund[3], TechnoFund[4], InnoFund[5] and NanoFund[6]. These four research grants are competitive and encourage industry and universities to form collaborative research projects before

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[3] ScienceFund is a grant provided by Government to carry out R&D projects that can contribute to the discovery of new ideas and the advancement of knowledge in applied sciences, focusing on high impact and innovative research.

[4] TechnoFund is a grant scheme which aims to stimulate the growth and successful innovation of Malaysian enterprises by increasing the level of R&D and its commercialisation. The scheme provides funding for technology development, up to pre-commercialisation stage, with the commercial potential to create new businesses and generate economic wealth for the nation.

[5] InnoFund is a grant scheme which funds the development or improvement of new or existing products, processes or services with elements of innovation. The project must have economic value and improves the societal well-being of the community. InnoFund can be categorized into Enterprise InnoFund (EIF) and Community InnoFund (CIF).

[6] NanoFund is a grant scheme which funds the support, development and research success in nanotechnology field and act as basis of New Economic Model. The scheme is hope to encourage collaboration across various institutions in multidiscipline and drive Malaysia to aim nanotechnology field as a nation core research and development.

funding is granted. The research grant support collaboration work was highlighted by Uni1:

> *"We have experience one collaborative partnership where they use us to get funding. Through the research grant, they bought equipment and use our space" (Uni1).*

Knowledge is a valuable asset for the organisation and collaboration is seen as the mechanism for knowledge sharing and transforming research results into commercialized products or services. The knowledge process is complex and dynamic, involving various levels of stakeholders. From the survey analyses in Section 6.5.2.1, it was found that almost 90% of survey respondents agreed that collaboration give high impact to their business in improving and gaining new knowledge of required skills and sophisticated technologies such as laboratory equipment and research testing facilities. This was also admitted by the interviewees to be the case where one of their drivers for collaboration is to gather and acquire new knowledge that could help transfer valuable knowledge and commercialise their research,

> *"We don't have any problem so far in fact we encourage working with them in the hope for transfer technology. Our university focus on link with industry because we feel this linkage is substantially important for the collaboration and commercialisation of our research and products. Also for the source of fund because the government now is cut down funding for research alone but increase funding if you collaborate with university and industry" (Uni3).*

Interviewee Ind3 also agree with this point by stressing that:

> *"Off course I agree. Any form of collaboration is good because it educates people. Again I come back to the same point; you must have something that are tangible that organisation can collaborate" (Ind3).*

Interviewee Ind4 also voice the concern of security and protection of the knowledge transfer. The support of IP as a knowledge protection could give more confidence for collaboration activities as commented by Interviewee Ind4:

> *"The advantage is that we can get more advance technology at the first place. We are the private company and research institution we can have the first information with them and also the first look of the latest technology being developed. If we collaborate and we have the edge of IP and so on and it is good for company and it's good for us and we can more business opportunity. We can explore more business opportunity" (Ind4).*

Another motive for collaboration was found to be the ability to access of labour and talent movement within the cluster to gain required skills. Labour movements in the cluster are also associated with the motives of collaboration in cluster. As discussed earlier in Section 2.3.1, sourcing of labour would be much easier in cluster and this also agreed by the interview respondents. Building up connections to the market and increasing business opportunities was the main objectives of collaboration based on survey findings (Section 6.5.2.2); with 89.7% of respondents indicating that it gives high impact to their firms. This was supported with interview evidence, Ind4:

> *"First you can have access of knowledge from university. Second you can get work force or talents and we can share knowledge for the industry" (Ind4).*

Further to this, interviewee Ind6 thought that collaboration not only benefits the local context but also beyond:

> *"The collaboration is important and we should have more collaboration with other big firm and outside countries and international universities. So we can (see) benefits from that" (Ind6).*

Here, actors in the MSC cluster including university, industry, government and intermediaries seemed to be positively encourage and supporting the functions of collaboration in strengthening the competitiveness of cluster. The most prominent drivers for collaboration in MSC cluster are; seeking funding, knowledge and skills transfer, business opportunities including social networking activities and the ability to access specialist facilities and equipment. These motivation drivers are summarised in Figure 7.6.

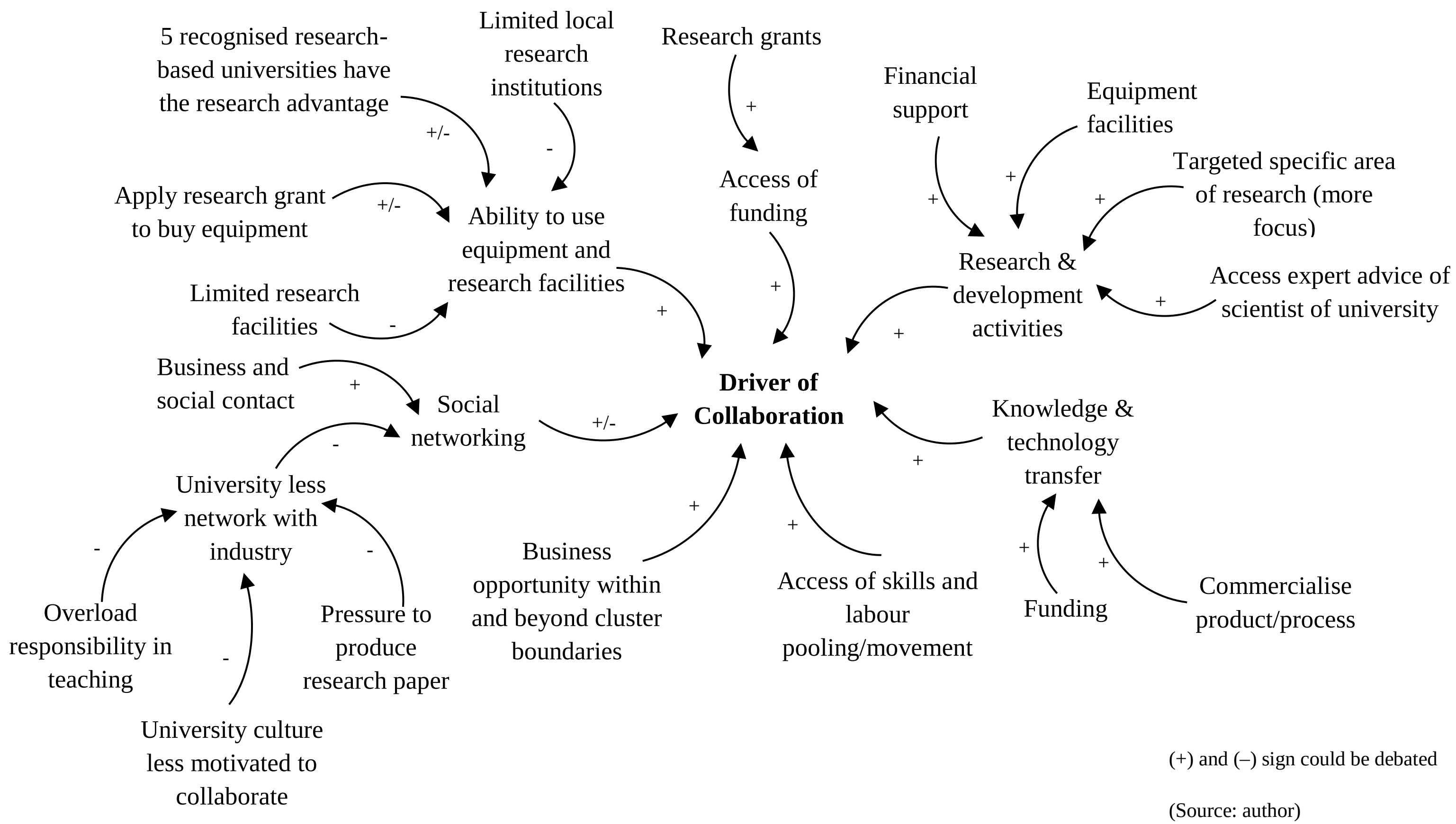


Figure 7.6: Influence on motives/driver of collaboration from interview respondents' perspective

7.5.2 Challenges and barriers of collaboration

Although collaboration has been recognised in contributing to cluster development, there were challenges and barriers that actors have to deal with. The issues include barriers and limitation of performing collaborative activities and its relationship impact between actors in cluster. These issues have positive and negative influence on the key determinants of successful cluster as describe by the interview respondents.

a. Low quantity and capability of local skills in science and technology.

The quantitative and qualitative data highlighted that Malaysia is facing issues on the limitation of talented local skills for effective technology transfer collaboration in the MSC cluster. Just over half of the survey respondents, 57.9% (Table 6.13) asserted that this limitation has a high impact in their collaboration process (approach) and relationships with partners. A related impact of this limitation found from interview respondents is the quality and capability of local skills in science and technology. An interviewee from a local bank, Fin1 said earlier on in Section 7.3.1 that universities are producing graduate without looking at their quality. This has negative implications for the industry when choosing graduates from universities to fill vacancies in their organisation. Meanwhile, Fin2 said that soft skills such as communication and interpersonal skills are still lacking and this has influenced the confidence of employer to recruit locals in their organisations.

> *"Local skills are still lacking and we have problems with soft skills issues like communicating and interpersonal skills. Conversing in English language is also a main issue. Also we have less technical and scientific graduates in Malaysia. I think the MSC has increase the number of IT graduates but still not many scientist" (Fin2).*

Adding to this, a majority of the interviewees commented on the limited number of local scientist and technical expertise working in Malaysia. The respondents also voiced concern on the capability of local university to produce local scientist associated with the lower number of scientist in Malaysia. Interviewee Gov3 explained this situation happen because most of local scientist is residing and working abroad which offer higher wage pay and better life experience rather than in Malaysia. The same comment also rise from interviewee Uni3.

> *"I think it just general issues in every country especially in the developing countries. Yes, we are lacking of talented local skills especially in technical and sciences field. Most of our talented skills are living abroad and they are comfortable with what benefits they get there. We feel this not only for government responsibility but us as academic institution. So part of try to maintain local skills here, we equip our student with courses in entrepreneurship and undergo for industrial training before they graduate. This will give valuable experience for our students and also job opportunity as well as opportunity to spin-out their own enterprise" (Uni3).*

This brain drain issue is important enough to see the government launching several programmes through its agencies such as Talent Corporation, Ministry of Human Resource and Ministry of Science, Technology & Innovation (MOSTI) to attract talented Malaysian residing abroad to return home and work in the country. According to UNESCO Institute for Statistics, 53,861 Malaysian students' were studying abroad in 2011 reflecting an increase of almost 30% in the past 10 years. There are no statistics to indicate how many of these students ending up not returning to the country. Thus, the roles of Talent Corporation as an intermediary have become crucial to integrate connection between locals studying abroad with local industry. Programme such as Returning Expert Programme (REP) lead by Talent Corporation had encouraged Malaysian professionals to return with 923 approved in 2012 compared with 680 in 2011 and most applications were received from Malaysians living in Singapore, the

United Kingdom, Australia, China, United States and United Arab Emirates, as reported by Talented Corp.

> *"Government is really looking this local skills issue very seriously. Government is looking for talent and we have Talent Corporation as an agency to tackle this issue. We have a lot of programmes and it is true that we are lacking of talent. So we are now given the task to work with Talent Corporation, MIDA and universities to come out with programme. There is proposal to identified talent in universities to absorb in the industry, the structure and the availability of jobs. The structure and salary is low and we have been addressing the issues. The talent issue not only for young doctor or professor but also this young technician. The issue is that the salary is low. For example technician work at Singapore is expensive rather than work in Malaysia. This is all to address the talent and at the same time we want high income and we introducing the minimum wages" (Gov4).*

This is still miniscule and the government has its work cut out to attract these students to return and contribute to the nation.

Apart from the limited local scientist, a majority of the interviewees have doubts about the capability of universities in producing graduates who are fit and ready for employment in the real world once they graduate. Industry perceives local universities as producing low quality graduates and that they (the industry) have to invest more in training and developmental programme in particular the soft-skills such as communication skills.

> *"Local skills always have been the problems. Back in 80s a lot of Malaysian coming back from abroad to work, that help for industrialisation of the country over the years. Come to millennium era, a lot of industrialisation is already mature. So Malaysia has grown into high value added industry which involves a lot of innovation and technology. This is what we are struggling at the moment. I think we have gap between what local university produce and what the industry really need to push us into the next level. That is an issue" (Ind1).*

> *"That one is our concern. The higher education in Malaysia doesn't provide graduates that fit to industry. What they provide is just the general basic need*

for industry. What we need is more than that. Which are more specific skills to fit our business model and that is an issue" (Ind4).

In addressing these industry observations on the quality of graduates, a university interviewee, Uni1, explained that university has internship programmes with the sole objective to provide early working experience for its students with firms. This interviewee also criticised the low participation from industry to work with the university.

"The industry just doesn't know where to look and how to get people (local skills) involve in the market. MMU have internship programme (for 3 months period) for its students to experience the real world" (Uni1).

Interviewees also highlighted the quality of local skills associated with the type and source of graduate's i.e. local and overseas graduates. They commented that Malaysian who graduated from an overseas university has more interpersonal and communication skills compared to those graduated from a local university. This reinforced the perception of the industry of the local graduate skills.

"We don't differentiate graduate from local or overseas. When we interview people, we have identified certain thing that we look for. Our screening process will determine whether you are hired or not. We have 2 types of screening, entry level and experience level. At entry level, it just straight forward, we grab those who has CGPA 3.5 and above. But the trouble is a lot of graduate is 2.5 and below. I'm not sure people notice that. This is not good enough for us. We check the language, we ask them one page essay, we look at it and the language is horrible. I'm telling you this is the serious problem. When you look at the CGPA is very low. I didn't understand why. For 3.0 we still consider, but 3.5 we just grab. When talk about quality, this is the issues. For experience people, when want to know where is your experience. A lot of graduate spend 2 years. What we want someone have as good foundation at least 5 years in a good organisation. University should know about this seriousness of quality that they produced. To me, it doesn't matter which discipline you are. I'm not engineered, I'm economist, but I'm in this technology business for last 30 years. Even in this organisation, not all of us are engineered" (Ind2).

English language proficiency was also mentioned by the interviewees in relation to the quality of local skills in science and technology fields. The issue of English language was also highlighted by interviewee Uni3 who said that subjects such as technology, science and mathematics should be taught in English as most references was written in that language.

> *"For local talents we have language problem and the expertise in IT and then communication problems. And government is looking hard to improve this area. In my opinion, the language that you use for technology, science and mathematics should be in English language as most references are in this universal language. I'm an academician and researcher, and it is hard to get people to change. But if the policy and environment of the university is encouraging their own staff like lecturer and researcher to be actively networking with industry and go beyond the teaching objective, I think our local university will be the same level as other international university. If we can control and maintain certain level of our resources then the output – in this case our graduates and our research outcomes will be on the top of the market" (Uni3).*

Based on the Ministry of Higher Education report in 2010, in total there were 1666 professors working in HE, including in Borneo (Sabah and Sarawak), with 1472 Malaysian professor and 194 non-Malaysian professors. As of 2007 report also from Ministry of Higher Education , academic staff working in Malaysia HE with PhD holder is 7779 and 13.5% is represent non-Malaysian. This statistic reports overview that Malaysia still lacking in number of expert with PhD holders in university and HE which could influence delaying the process of quality improvement of university and graduates. This issue was mentioned by interviewee Ind3 that Malaysia does not have enough PhD researchers compared to other Asian country such as Taiwan.

> *"For implementation yes and no doubt we can implement but again if we focusing in R&D far fetch for us to do it locally. What I was told at Huawei they have thousands of students doing PhD and R&D how are we going to compare with that environment – impossible. Maybe it is good strategy to have thousands PhD holders and doing research rather than having this fabulous plan ask them to create products. This could be one way to do it like what China is doing. They have a lot of PhD people and brains and a lot more focus and they have big domestic market. What happen here in Malaysia is that we want the best which*

Malaysian company cannot produce so we still have to buy from overseas and how are we going to do R&D in Malaysia? Even now we buy train from China. Most companies are looking at overseas" (Ind3).

Interviewee from university Uni4 admitted that the learning process at the university for students are concentrating more on teaching purposes rather than educating and training the students to be ready for employment. Uni4 also claimed that the industry should take responsibility to further train local graduates upon employing them.

"Again I've to talk about gaps. We don't train unless industry comes to us. We are producing graduates that are adaptable with the industry. We are in transition. Our academic staffs are moving into research and we are still relatively new compare to international universities like Aberdeen. I'm sure it'll evolve. Right now I'm not happy with the way academics train their students but they have not come (past) that particular stage." (Uni4).

b. Lacking of marketable research

The next issue in relation to collaboration in the cluster is the type and value of research and development. The perceive value of research done by the university is found to be one of the major barriers of collaboration by interviewees from government and industry. There is a lack of confidence in local firms and industry to become actively involved in collaborative work with university. The source of this argument is the type of research conducted; being mostly difficult to commercialise – with research findings often not relevant and attractive to the industry. To industry this clearly has little immediate marketable value, leading to a perception of a lack of understanding of the dynamic concepts of innovation among researchers in local universities.

"There is a gap in research especially the applied research in the university. Innovation should be led by research that has commercialisation value. Innovation is not about changing company's logo but the application itself" (Gov4).

> *"Relationships with our R&D are market driven. That means we allocate to the market the money that we pour into R&D. The university on the other hand are not market driven. Their market and interest in technology is to discover something novel. The matching is not there and some research is not relevant to us. We have a number of MoU but the work is missing a lot of pieces or not complete. There has to be greater engagement. One university came to us and said they have 13000 innovation projects that they are working on. We have a difficulty to look at these. And they have the entire database. Our R&D is set to market. That means we work with potential clients to find solutions and try to understand the technology required behind it, we look for it, we do a technology scan across the world for it and we build it. But when we scan with the university, they have a lot of incomplete pieces" (Ind2).*

Half of the survey respondents (Table 6.13) indicated that different interests and objectives of collaborators as a one of problems for initiating collaboration and consequently this have a high impact on their organisation. A majority of interview respondents also criticised universities for demonstrating little intention to be involved in collaborative activities.

> *"University is not really active to collaborate. Sometimes the university doing research for the sake of research publications but not for the result and value added research that can be commercialised. University is more concern to produce big number of graduate and not looking after the quality and also the result of research is not value enough to make money. I said this because we have experienced working with some local graduates here and some of them we are quite happy but majority are less confidence and need a lot of guidance. The project that we collaborate at the end was well-worthy but we certainly learn our lesson when handling projects with university" (Ind6).*

By contrast, interviewees from university argued that they received less support from industry in appreciating their research ideas or findings and, lacking strength in trust and commitment for effective collaboration. Impatience for research results is another negative indicator received from the university upon their collaborative work with industry.

"The industry they look down on local ideas and they don't have confident level in terms of commercialisations. Whereas universities especially the RUs (Research Universities) they went all out in this innovative and commercialisation. Before this they only focus on innovation and then they just keep it (research projects) on shelves. Once you get the patent, that's it. Now, they are going into profit making this patent. They are trying to entice industry to come in. Most of the time, small local companies involve which is not really big giant international company" (Uni1).

"In research we cannot come out with quick return and results. The industry is so impatient. All I can say to industry is that throwing some money and that 5 – 10% return is good enough. We are putting a lot of things. Industry is feeling to move into research but they do not do research. That is what happens to TNB, they have started selling their technology and make initial research then they move on. Our industry is still flying by night. This is the gap between industry and university" (Uni4).

c. Poor commercialisation and market connection

It was found earlier in the survey (Table 6.13, Section 6.5.2.2), that factor of 'inexperience and difficulty in connecting to market such as marketing and commercialisation activities' emerged as one of main problems for collaboration, with 63.6% of survey respondents specified that it had a high impact on their organisation. This poor knowledge and experience of commercialisation is further confirmed by the interviews conducted. Interviewees criticised local firms who are not confident to take on their research and produce product outside local markets. The issue also relates to the dependency on government and intermediaries organisation to assist in the commercialisation process.

"Most local firms are afraid to do so and they are still need government support to do that. MATRADE, MIDA, SME Corporation and even MDEC have a lot of programme that helps our local firms for this. Yes, some firms are not experience on this but with these government agencies should not be a problem. As I said earlier, if we encourage our people from the early age, they will confidence to market their product even no experience and the role of government agencies should fit the gap. Most of the failure company is because they don't seek help from these agencies and at the same time their product doesn't have sound of marketable value" (Fin2).

> *"Attitude of our local firms is afraid to compete in global market unless they get support from the government. I think they depend so much from the government but that was in 10 years back but not on these days" (Ind6).*

It was discovered that certification such as quality standards and software security protection are important for accessing international markets; interviewee from government, Gov1. The interviewee also said that efficient and credible support and role played by intermediaries could aid local industry in acquiring the related certification from trusted organisation. However, complained that local intermediaries lack practical and industrial knowledge to be of assistance. Furthermore, interviewee explained that cost to acquire certain certification is expensive, and government (MOSTI) was planning to establish a centre specifically to assist and fund industry to obtain related certification.

> *"For our industry to go to market, we realised that there are a lot of barriers especially in global market, as you know because global market look at certification. Certifications are very expensive and we called that non-tariff barrier. In realising that what the government is fostering to do to set-up 'shed centre' where government fund some certification for example in term of security software, common criteria and some sort of certification for quality. We realise we need to subsidise the industry for obtain certification so that they can be competitive in the market. So this is one ways we helping them with this kind of facilities where they can come and being certified and they can sell it. This is government role. What MDeC doing is taking industry to market actual where in value of chain they can play. Let's say software in e-solution and there is demand in Korea for example. So they will take the company to Korea to do the pitch and try to get some linkages. We need a lot of business intelligence to do this. Companies like MATRADE and MDeC have to do a lot of business intelligence and they have to know the business area. The people in MDEC and MATRADE should have that capacity. May be some restructuring involve for example in MATRADE need to know the business area before they can say Ok we can go here and there. Otherwise they just become two operators which we don't want that. What we want are people who are knowledgeable" (Gov1).*

Interviewee Gov3 also explained that poor commercialisation is associated with lacking financial resources due to high cost involved in research and development of new products and technologies.

> *"We have a few government agencies to commercialise their product. The problem is that start-up company as they have less money to market their product as they have use most of their money on research and development project"(Gov3).*

As mentioned before in Section 7.3.2, Malaysia has yet to produce any leading technology can be attributed to poor management of the commercialisation process. Interviewee Ind2 also explained that there is not enough support and continuation after the product or research launched into the market. It is reflected in the failure of local technological products to reach global market. In contrast with what was mentioned earlier; Ind1 said that government is very supportive through government agencies who act as intermediaries to connect the industry to potential market. The only concern and challenge is to acquire appropriate resource for the firm to grow.

> *"So far again you know about connecting the market, Malaysia is quite open and a lot of people can get services and product to the market. The government has been quite supportive to help us in this. The main issue is the resources like people, capital, land and space. Getting product to market is not the problem" (Ind1).*

Interviewee Int1-A added that there is lacking of sharing knowledge and collaboration between university and industry that disconnect between them and also the market.

> *"The disconnection happens because lack of collaboration and sharing between academic and industry. If both parties willing to share, I believe university or academic will be the best people to work along above expectation" (Int1-A).*

A majority of the interviewees from university agreed that commercialisation is important for their research and development; and therefore has setup their own centre for both collaboration and commercialisation activities. However university is facing challenges to assure industry of their new capabilities in connecting the market through its role in collaboration and commercialisation as well as producing graduates with technology and soft skills ready for industry.

> *"MMU is active in collaboration work with industry. We find it useful and important. We have our own collaboration and commercialisation centre. What we do here is that we choose who to collaborate with based on what we do here. Usually we have 3 – 4 projects and not more than that at one particular period and assess what mutual benefit to university with this collaboration. Some of activities we do including school joint projects, staff or students exchange with industry, conferences, open programme and courses with industry; and also our facilities like equipment and expertise. We also have collaboration inside university and we have our R&D road map. Our challenge with industry is that to get them to understand on university's capabilities. University cannot produce 100% industry ready graduates. It means type of graduates they need both in technology and soft skills such as ideas & creativity" (Uni1).*

> *"The government is trying to do all out but there is no buy-in, acceptance and involvement. The university do it just for research sake. The commercialisation is quite new here. The MOU is only last for 3-4 years and then it is quite, we are still not active. The problem is the industry because they are very sceptical to step-in" (Uni2).*

The interviewee from university also admitted that they are dependent on government and intermediaries for commercialisation and connecting to market for their research. This is mainly due to their limited knowledge and experience in commercialisation activities.

> *"Internet is good in connecting for international market but we still need help from government agencies like MIDA. MIDA are very supportive in helping firms to market the firms. We have one collaborator uses solar power for the renewal energy industry and uses MIDA to market it. I would say it is helpful to tell people in the same industry of what we could offer. Our division of Technopreneur Development and Innovation Division (TDID) is the centre that is responsible to coordinate, promote, manage and supervise all activities pertaining to the technopreneur development and innovation. So they act as on behalf of university to connect to industry and also to other government agencies like MIDA, MATRADE and MITI. Through this relationship we hope*

we could move our research further and be known by others of what we are currently doing in terms of research and commercialisation" (Uni3).

Due to limited experience in commercialisation, universities have outlined several requirements to their potential industry collaborators before participating in any collaborative work or agreement. This includes the requirement that the firm (industry) should have significant previous experience of commercialisation activities.

"One of the criteria before to collaborate is that the partner should have the experience in market and commercialisation as we don't have enough expertise in this. Usually MDeC will help us in this if we have difficulties in this issue" (Uni1).

Interviewee Uni4 stated that connecting to market and commercialisation issues are among the challenges and gaps that currently exist between university and industry.

"That's our gap at the moment with industry, connecting with the market and commercialisation" (Uni4).

d. Limited research funding and financial support

Table 6.9 highlights the finding that a longer process of financing is regarded as the second highest barrier (mean score of 3.72) to collaboration and rated is as having a high impact (62.5%) on their business. This was also mentioned by interviewees, where other related issues associated with it included limited research funding; support from local financial institution, venture capital, intermediaries and university; and failure of the industry in exploring funding opportunity with local university.

Two of the interviewees (Ind1 and Gov3) confirmed that support from local financial institution is not appropriate when compared to other countries such as the UK and

Australia. They blamed a poor banking structure in Malaysia, particularly the financing process, which makes it difficult for local firm to acquire a business loan. Interviewee Ind1 further criticised the local financial and banking system as not friendly and supportive, as well as sceptical about business proposal and investment proposals made by local industry. They (the financial institutions in Malaysia) was also criticised for setting very strict collateral for applying financial support for businesses.

> *"Malaysia is quite liberal in banking sectors. We get offer from bank. Unfortunately while bank over here are happy to lend, their structure and instruments for lending is not as friendly as in some other countries. For example over here, if you don't have collateral or security, the banks won't lend you anything. This has been tradition way in this country. In country like in UK or Australia they can lend you if you have some very good idea that is workable, they will give you money. This is good to spur the innovation. So banking sector in Malaysia need to change their mind set because they are so risk averse which sometimes doesn't help to increase the innovation" (Ind1).*

In contrast, four interviewees (Int4, Ind3, Ind5 and Ind6) stated that financing is not a major challenge for collaboration. Interestingly, Int4 claimed that delay in receiving funding is an issue which somewhat contradicted the point mentioned earlier. This delay happens due to insufficient documentations from the applicant. An interviewee also admitted that are changes and improvements to the financial process these days, where it is faster, transparent and easy to access.

> *"It is not so much on us. We run as private. We have standard procedures. The problem is when you not follow the procedure like not enough documents and this delays the process. It has improved a lot" (Int4).*

> *"There wasn't so much of problem before but with the current economic climate we have seen a delay in approval for funding. But this is inevitable in the current climates" (Ind5).*

> *"For us which we are privately funded, so we don't have any real problems in financing. We are in commercial and mostly deal with commercial bank which they look at our track record. I think if we want to get some grant for instance that might a problem" (Ind3).*

> *"Financial is not so much because our local bank and financial institution is encouraging companies in research. The process is quick, transparent and easy to access. Also they have support from the government to encourage firm to ask extra funding. I don't see any problem in this" (Ind6).*

Adding to this is the view of interviewee Gov3, who explained that the funding issues generally happen when companies seek further funding for their commercialisation activity upon the depletion of previous rounds of funding. When this situation occurs, the financial institution including local banks and venture capital are reluctant to fund as they are concerned with the risks involved. Furthermore, the R&D investment by companies in Malaysia for 2011 is 1.07% of GDP (MASTIC, 2013), which is not healthy to promote growth of innovation.

> *"However funding is one area and also an issue. There are not many funding from bank or venture capital who would like to take the risk. It is quite difficult for new players to enter the game. For example if you want to go in new area, you need a lot of research done and this involves a lot of money then you need for full commercialisation. This is where a lot of company get stuck. They have done research with university, probably at the development stage, and then they need to bring it to market which this is another story. This is where the government see the gap and we have some incentives to help the industry in this. Our funding in R&D GDP is quite low and came down compare to last year plan. This is one area of concern. If we compare with US, Japan, Korea and even our neighbours, their percentage of R&D GDP is 2% or more and we are not even near 1%. This is the critical mass, do we have expertise? We are trying to collaborate with centre of excellence from overseas. Our minister is actively doing international collaboration with foreign companies and countries" (Gov3).*

Another facet of financial issues is the role of venture capital in Malaysia which appears not to be supportive of the local SMEs in technology industries since these firms are high risk compared to other industries. The criteria on return of investment imposed by venture capital was also criticised by Ind1:

> *"Venture capitals here are quite friendly. They only want to be with you or invest in your company with an idea of exciting. They will only with you for*

> *certain time frame until they can have their money. Sometimes the criteria they set makes it impossible for example they want 20% return per year otherwise they will go out, this sometimes difficult for some businesses to survive. Venture Capital Malaysia is only important for SMEs but not for industry like us" (Ind1).*

Interesting points emerged on the lack of capability and the somewhat unclear role played by intermediaries in providing support including financial resources to both university and industry. Interviewee Int3 observed that there are many government agencies i.e. intermediaries that have similar strategic roles and responsibilities in commercialisation, funding, training and development; which confused both university and industry. Interviewees also suggested that there should be clear and specific role defined by each agency:

> *"Without a doubt there are some firms has knowledge on this but for those who not, we as intermediaries are the main contact to solve this issues. As I said earlier on, the firms are afraid to step forward and there also too many government agencies doing the same task and responsibilities, which confused the industry. There should be one agency that can handle commercialisation, and others can do funding or training for this young companies" (Int3).*

> *"We do technology transfer through licensing and we earn the commission of licensing. We are agencies under MOSTI but now we are under MITI. We are designated for technology commercialisation and our role just in 6 years of operation. The main core business mostly is research fund. Commercialisation has its own research funding. Unfortunately the from MOHE because they have broad area – flagship area. MIGHT also have this type of research funding. We are trying to do more on mix-matching but it is very exclusively. Research we have to per head per year – MASTIC report. The thing is the matching – orchestration where u need team and material and project. Some university is ok, maybe some of thing we don't have. I went to India, Russia and Uzbek, u can copy the technology u can capture 70% because the rest u need the knowledge. If you look at Japan – photocopy machine, Minolta. We do research, is there anyone have patent the project" (Int3).*

Furthermore, interviewee Uni1 mentioned that there are insufficient support of funding for university to perform research and collaborative work. The allocation of research funding or cost structure is different depending on selected area of research, research time frame and commercialisation process involved. The interviewee also explained that these factors of research cost structure have made the funding for ICT and creative industry difficult to obtain.

> *"Leverage the support in timely way because there is no sufficient support in financial. Collaboration is good but the understand ability of research cost is very different. The fund of ICT & creative sector is difficult to obtain due to its short-term project. E-content research is simple and the fund needed is for contents (depends on what type of contents they are) and output to commercialise" (Uni1).*

Universities in Malaysia have the capability to fund research projects through collaboration; however, not many in industry are unaware of the availability of this support mechanism and funding direct from universities. This failure on the part of the industry is claimed by Uni3 and Uni4 to be due to lack of enthusiasm and appreciation for collaboration with local universities:

> *"If the company seeking collaborative grant or fund with us, we will be over the moon but it is hard to get them to come to us. Obviously you need to screen their background first. Since 2005, we have a lot of collaborative work with industry and I think our policy is a bit different from other local university where we really committed for industrial collaboration. Government also at the same time is encouraging industry to work with us for more funds. The only about industry is they can't wait for too long and they expect a quick result. Yes we do understand this situation and that why our research is much to be more applied research that have the commercial value. So far we don't have problem about that. It is an honour to us to support the industry. We have done a lot of research fund or grant in engineering, telecommunication and manufacturing involve in IT" (Uni3).*

> *"We are trying to facilitate industry. The industry is not taking the opportunities to work with us as we have a lot of grant – we are the gold mine. They just waiting the opportunity to come to them but they not search the opportunity with university. A lot of academic staffs are complaining*

where they have to do a lot of work such as to become entrepreneur, market the product and research" (Uni4).

e. Bureaucracy

Referring to the Global Competitiveness Report 2011-2012 (World Economic Forum, 2012), inefficient government bureaucracy is the most problematic factors for doing business in Malaysia. Both survey and interview data also highlighted that bureaucracy is the top challenges and problematic factors for collaboration in the MSC cluster including in universities and government. The mean score and cumulative percentage of impact distribution (Table 6.13, Section 6.5.2.2) showed that just over two-thirds of respondents agreed that bureaucracy and too many authorisations causes prolonged times before the start of collaboration work. Following on this, interviewees (Gov3 and Ind6) mentioned that red tape, slow process in decision making and less research focus affected the collaboration work. Thus, university and industry are both reluctant to work together and comfortable working on their own research. This showed there existed low synergies between university and industry:

> *"The feedback we get from industry is the red tape, slow and they are not focusing research area of what the industry concern. Time is what industry concern with the partner. It is difficult unless the university be able to produce what the industry required. At this point of time, I personally don't see strong relationship between university and industry. When we ask both of them to work together, they seems reluctance as they feel they be able to work or do research on their own" (Gov3).*
>
> *"Bureaucracy is the main issues to handle. It is not only from government part but also at the university level. We have experienced working with university and it took us more than 6 months to get final agreement and consensus on decision to proceed with the collaboration work" (Ind6).*

Adding to this, interviewee from university (Uni1) admitted that bureaucracy is a barrier between university, industry and government.

> *"Bureaucracy is a stumbling block between the government to industry, and university to industry and vice versa" (Uni1).*

Interestingly, several of the interviewees (Ind1, Ind4, Fin2, Uni3 and Gov1) perceived bureaucracy as policy and procedures to control practices and not as a negative implication. However, concern on the process of the practice could be made simpler and transparent to avoid delays in decision making.

> *"Well we have no problem with government. You need sometimes bureaucracy as to control but it should be as simple as possible" (Ind1).*

> *"Not so much. Everyone have their own standard practice. Off course government is the most important but there is a reason why you need a policy and procedures" (Fin2).*

> *"Not so much about bureaucracy. This has improved a lot compare to 10 years back. We need policy and procedure that can help us checks if we are doing the right thing or not. If there are policy and procedures need to follow, we should follow but we need to shorten it a bit and simpler and transparent" (Uni3).*

> *"I don't think that is an issue now because the government is clear that we need to actually foster good relationship with both between industry and academia that has been fall prize. I don't think there is any issue" (Gov1).*

Interviewee Ind4 was concern with the lack of knowledge of officers involved in the decision making process on funding, and the speed of managing of projects could slow down the collaboration process.

> *"We cannot say that bureaucracy is the main problem for collaboration. Bureaucracy is the procedures and not tapping of the collaboration. The officers within the line sometimes lack of knowledge and that could be tapping the process of collaboration" (Ind4).*

Interview Gov2 admitted that the rate of bureaucracy has reduced and credit should be given to the government agency PEMUDAH's (Special Task Force to Facilitate Business) effective role in monitoring and altering the process. Interviewee Gov4 said that PEMUDAH has improves the administration and decision making time from a few months to 2-3 days.

> *"Bureaucracy has reduced a lot. That's why we have PEMUDAH - they try to reduce bureaucracy process. The government is providing services and the Chief Secretary always stress out about the need to put everything on-line. By having ICT, this can be streamline. Each ministries involves in ICT not only link with everyone but we always have links with each other" (Gov2).*

f. Mutual agreement and trust value

Trust has been identified as one of the contributing factors to support firm development in the MSC cluster (Table 6.6); and motives for collaboration (Table 6.12); where both are rated by survey respondents at just over 60% for high impact to technology firms in doing business. The interview analyses highlighted trust as important in collaboration and is embedded in the contractual agreement in the early stages of collaboration. It was found that mutual agreement and trust does not contribute to major barriers for collaboration but it is crucial in the early stage of collaboration. Interviewees also commented on a healthy relationship between trust and social relationships in collaboration could enhance business operations. This indicates the importance of networking as trust building process and knowledge building practices among collaborators in cluster; knowledge spill-over via network acquaintances have more intrinsic trust (lower communication barriers) that in formal business circumstances.

> *"We do have it. During discussion and I always make it clear. Without trust we cannot go through for it. The trust is binding in the agreement. After few discussions we sign an MOU just for formality" (Ind4).*

> *"It is not an issue as long as the agreement has been agreed in the beginning. The first meeting is important and also your network connection with your partner. Usually we know our partner before we decided to collaborate on some projects. To me business networking is important as it make you do business easier – so you trust them" (Fin2).*

The culture influence and government policy is also said to have an influence in trust building as commented by interview Ind1 and Gov2.

> *"In our case, the law of this country is very clear because we have British-based law. So it is quite clear and trust issue can be mitigated by having proper agreement binding in law. Not like county in Pakistan or Iran because when you sign an agreement it doesn't means anything. So people scare doing business there. Our law has helped mitigate about trust so we don't have the problem of it in here" (Ind1).*

A majority of interviewees (Ind2, Ind6, Fin2, Uni3 and Gov2) indicated that trust formation processes should be built in the early stage or before formal collaboration occurs. Trust can be developed through participating in social networking activities which later turns into informal contact networks. From here, the potential collaborator has an early indication and/or perception on potential partners. Thus, the early stages identified as crucial in the process also depends on other organisational factors such as commitment and behaviour of people involved in the collaboration process as highlighted by interviewees (Gov2, Ind6 and Uni1).

> *"I don't think our culture has a bad influence. We are unique and we like outsiders. We are very patient and I don't think we have issues in trust while doing collaboration work. The most important is the early stage of the collaboration when you want to choose your partner and on what basis you select them. Usually we know our targeted partner as we know from a lot of business networking. Trust can come when you start to know them informally" (Ind2).*
>
> *"Not a problem at all as long as the project suits with the objective. We have international and local collaborative initiatives. You can look at our website on what type of companies we have experience with and still continuously working with. Based on experienced, the initial stage is important where you try to build the relationship and trust between your collaborators. I think if you know them first before the project launch is much better as it much easier and comfortable because you have talk and networking with them as informal before" (Uni3).*
>
> *"Trust something that you have to earn. The relationship must be there first and then you talk about trust. Cultural is part of it but in Malaysia most of it different case by case basis, some you trust and some you just cautious. Relationship you need to build it first then you can build that trust.*

Sometimes it takes time to get the trust. Trust is important element in collaboration. How you build it depend on such organisation or people who involves in it" (Gov2).

"I don't see this as a problem. The main important is the first meeting with collaborator where this is crucial where you this is the stage where you named of your need and then from there you try to negotiate what best for everyone. So to me, I think this is the crucial process" (Ind6).

Another feature of trust building discovered during the interviews is that trust can be learnt through previous experience. The experience has made the collaborators more vigilant on choosing the right partner, commitment and motives of collaborations.

"Do your homework on who work with you i.e. background check. We have experience one collaborative partnership where they use us to get funding. Through the research grant, they bought equipment and use our space. Later in few months, the company had disappeared. So we learnt our lesson and very careful to trust our partner. We do background check and we stress-out about commitment in collaboration and also the result or objectives that we want to achieve" (Uni1).

g. Personal objective and commitment

It was discovered in the interviews that personal objectives and commitment are another challenge in effective cluster collaborations. Interviewee Gov4 commented on the lack of commitment and responsibility of industry's collaborators in finishing the project. The intention is for securing research funding or research grant from the government agency rather than commitment to completing the collaborative project to the desired quality. To further reduce this, the government has changed the policy from research grant to research loan in the hope of increasing responsibility among researcher to be committed in their research collaboration.

"This is what the government trying to move. We give grant to private sector. When we give grant there is no commitment from company. If we give loan then they have commitment. Now we are considering the grant into soft loan. This is to help change the seriousness and commitment and also to

show to be more productive and commitment and seriousness in finishing the project" (Gov4).

h. Awareness on Intellectual Property (IP) and patent

Based on the survey (Table 6.13), there were 30% of respondents who regard unclear policy and guidelines of using patent as a barrier for collaboration which can give impact to their business. The interview respondents also voiced their concern on the issues of IP and criticised that there is low awareness of IP in Malaysia especially for SME's. This challenge could affect the effectiveness of collaboration in particular the security purposes.

> *"We always concern about IP. The IP is always belongs to firms and we just helping them to market product successfully. This is something belongs to the firm and we always advice firms to have IP or copyright on their products. The government cannot own the IP and its better for firms to have it. Every year we have IPO seminar where we want firms to know how important it is to protect their product or idea in the market"* (Int4).

Interviewee from university Uni4 also admitted that among research in university, there is still a lack of awareness on IP. The total number of patent are also limited as compare to other research universities.

> *"UiTM has minimal patent and we are looking into how we are going to increase IP. We are still lacking in this IP" (Uni4).*

There is urgent need for effective enforcement; and increasing awareness and knowledge of IP among researcher in university and industry. This is to protect and secure the originality and ownership of the products and processes among competitors as mentioned by interviewee Ind5:

> *"We don't foresee any problems with our own capabilities and IP as our products and processes are highly specialised that it is very difficult to replicate without the right technical know-how. However, certain companies that I know have been faced with problems in ensuring that their products are not counterfeited and sold as genuine. There is still a lackadaisical attitude in*

enforcement of IP on the part of the government. Companies need to really be proactive in putting their case to the government in order for them to take action. Nevertheless, it is improving though not fast enough" (Ind5).

Interviewee Gov3 suggested that the university should reward researcher in university through commission and royalty payment to encourage spin-outs and avoid issues of ownership of patent.

"There is an issue in here especially the ownership. If you are government servant you cannot set-up your own company due to some regulations. For academician there is some conflict and some rules discourage them to do. However, some university likes in RU's for example USM, they offer reward in terms of commission and royalties for them. This will encourage more academicians to become entrepreneur" (Gov3).

Interviewee Gov4 also mentioned that roles played by intermediaries could support and increase the awareness of IP as well as educate the SMEs on the benefits of having patent. Furthermore, interviewee criticised the attitude of local firms in not taking R&D and IP seriously. This creates the possibility that local R&D might not be compatible or ready to compete in international market.

"If you talk about R&D - we are just 1% if compare to other country. I think because we cannot say foreign firms do R&D but local company is a bit slow in R&D and they not train to be R&D. This is why Domestic Trade Ministry promote IP because big companies they have patent. If you have patent their value is good. Our company don't have patent and not aware to the benefits of it. It is also human value of business culture. In Malaysia 90% and above establishment is SMEs so they think they don't need patent and this is another issue. That's why we have SME Corporation to develop the SME. They have a lot of programme, not only give assistance of finance and also human resource development, adviser and they come-out with SCORE. SME Corp will give score in terms of Star – they will assist them from 1 start to 4 start. When they at 4 star they can be independent like they don't need help in finance and marketing and other" (Gov4).

As overall, the challenges and barriers of collaboration in the MSC were because of the weak impact of key determinants in the cluster development. This includes limited local skills in science and technology fields, poor knowledge and funding in commercialisation process, bureaucracy and lack of awareness on IP issues.

The summary all of these challenges was illustrated in Figure 7.7.

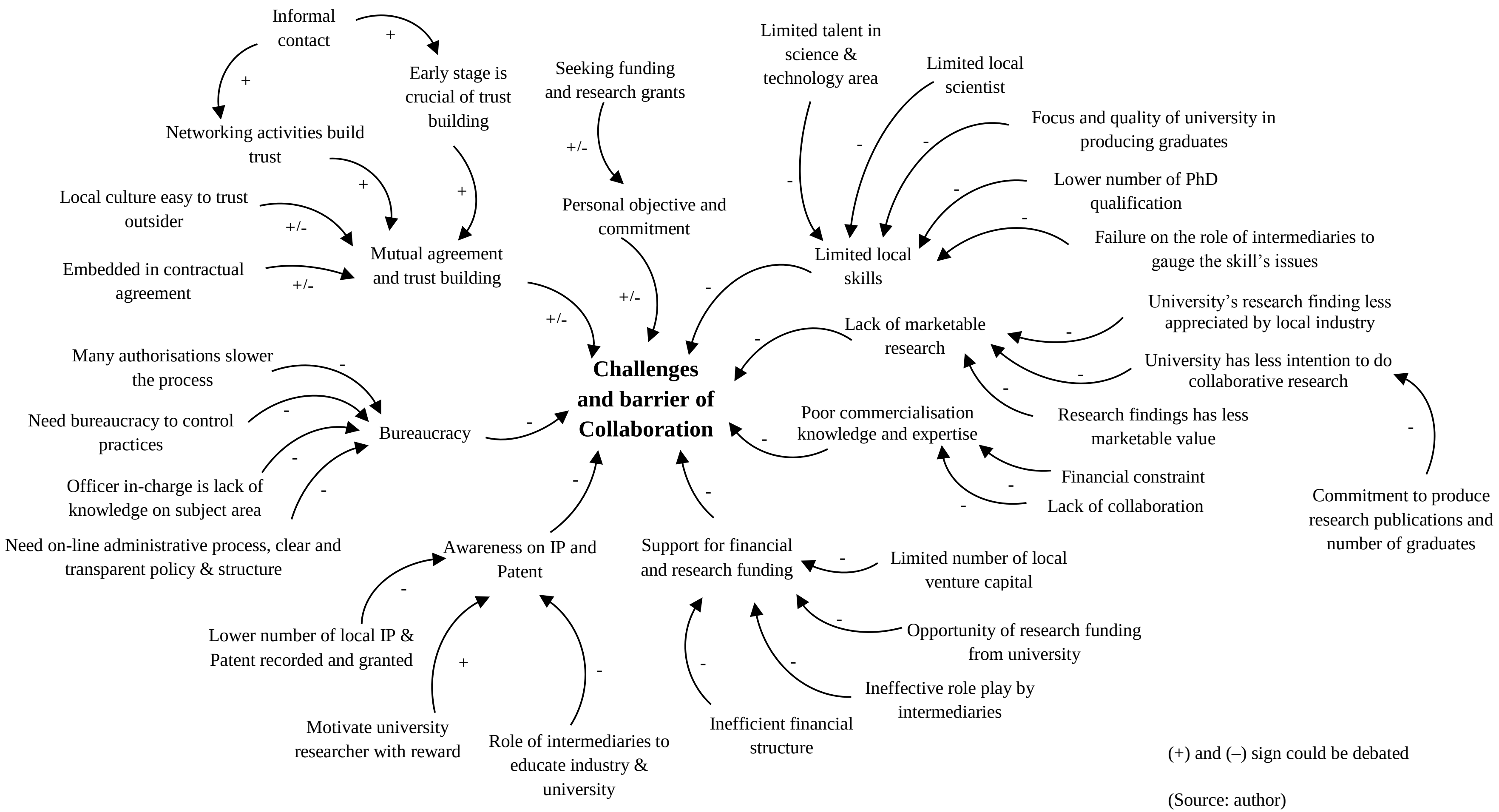


Figure 7.7: Influence on challenges and barrier of collaboration from interview respondents' perspective

7.6 OTHER ISSUES DISCOVERED: ENTREPRENEURIAL UNIVERSITY (EU) IN MALAYSIA

Other issue discovered during this investigation relate to the so called “Entrepreneurial University” (EU) concept. Etzkowitz (2003) explained that an entrepreneurial university (EU) has an extension of the classic two mission university: teaching and research, to participate in economic development activities through capitalising its knowledge: the third mission. Interviewees in this research were asked for their views regarding the readiness and capabilities of Malaysian universities to becoming EU. Some interesting views were gathered from the interviews including on university organisation, culture, structure and resources; their capabilities in R&D and commercialisation; and linkages between university and industry. The issues and views drawn from the interviews were then summarised in Table 7.4.

A majority of the interviewees agreed that an EU is a new concept that Malaysian university should embark on and some of the interviewees, notably Uni3, Uni4, Ind1, Fin1, Fin2, Int4, Gov1 and Gov3, agreed that Malaysian universities are generally not ready to become an EU but they have witnessed changes in those universities that are currently working towards becoming EU. These include changes made to the organisational structure of the university where there is now a deputy vice-chancellor (DVC) for industry and commercialisation position being created in most Malaysian universities; particularly those assigned with research status. This is seen as an early initiative by the universities to increase R&D; linkages with industry and government; and commercialisation activities of university’s research and knowledge output into potential market. The DVCs are also responsible for the management and operation of a university’s commercialisation centre (technology transfer office).

> *"That's why university such as research universities are introducing position of deputy vice chancellor in industry and commercialisation. Before, there were only Deputy VC in Academic, Deputy VC in Research and Deputy VC in Management and now there is also Deputy VC in Industry & Commercialisation. All the research universities have it but small university don't as they're small scale and (have) no specific DVC under that and still under R&D" (Uni2) .*

Interviewee Int3 criticised the role of vice chancellors (VC) in Malaysian universities is fast becoming politicised whereby the VCs set high hopes and mission for the university to achieve such as becoming a centre of excellence without considering the overall capabilities and resources of their universities.

> *"VC here is like politician as well. UniKL is best example. UTM, UPM and UKM they have their own incubator and research centre. But some of them it's just cosmetic because we need to have but the people itself we don't have enough capability" (Int3).*

Int3 view is very critical of not only the VCs but also Government Ministers and industry can be seen from the view put forth below:

> *"The Ministers are a bunch of dreamers with their long term projects and Universities have become caught in this. It's the same with industry but their dream is different but tends to reflect market needs. Everyone wants to be centre of excellence" (Int3).*

Even though the concept of EU seems to be well accepted among Malaysian universities, the university's culture itself is still reluctant to make the change towards becoming EU. Surprisingly, this is a view of one of the interviewee from university (Uni3). This is attributed to the confusion among academics and researchers on the main objective of what the university would like to achieve i.e. are they required to produce graduates ready for the industry through teaching; should they be creating entrepreneurs through entrepreneurial education; or are they required to develop research that can be commercialised and become entrepreneurs themselves. Apart from this confusion and additional responsibilities (becoming an entrepreneur), there are also pressure among academicians, researchers and non-academic staff in university to meet individual's key performance indicators (KPIs) such as to produce research papers in quality international and local publications. This KPI-based performance was introduced by the Ministry of Higher Education (MOHE) to all Malaysian universities particularly public universities in order to meet the vision of Malaysia in becoming as a Centre of Excellence for Higher Education by year 2020.

> *"We have five Research Universities in Malaysia. UNIKL is quite new but we are more focused on entrepreneurial activities and more links with industry. There is a lot to be done before we can be Entrepreneurial University. This concept should not be confused with the original responsibility of university as knowledge and talent producer. Our issue here is some lecturer is not really committed to play more than one role academician, researcher and entrepreneur. There is too much work and at the same time they need to achieve their key performance indicator (KPI). This is our issues at the moment. Some confusion of what the university really want to achieve whether to be excellent in producing knowledgeable talent or being an enterprise" (Uni3).*

The MOHE has also awarded five local universities with Research University status which gives them more freedom in managing the operation of its institution. However, one interviewee (Uni4) criticised that RU's concept as unclear on its purpose apart for obtaining a perception of being prestigious and privilege.

> *"The gap between universities is not so big in terms of competition. By having title as Research University you are easier to get more grants and government give you privilege. It is all just for prestige and perception. I don't believe in that" (Uni4).*

Interviewees Ind6, Fin2 and Gov4 feels that Malaysian universities in general still lack the required resources to become EU such as funding; facilities; equipment; and expertise such as quality lecturer and researcher with PhD. Their views are represented below:

> *The quality of local lecturers and academician also has to be in line with the objective of university to be entrepreneurial university. There should be lecturers that have industrial or business experience working in the university, so the students can share their real experienced (Ind6).*

> *"I can see a lot of university trying to go for self-funding but there is a lot to catch-up. Funding is always the problem and also the quality of lecturer itself. Now most university require its new recruits of lecturer to have a PhD" (Fin2).*

A majority of interviewees Ind1, Ind2, Int2 and Gov1 are concerned with the level of commitment and capabilities of universities in conducting R&D that could potentially be commercialise. They argued that the R&D culture in university should be supported continuously focusing on areas that the universities have expertise on.

With regards to research that have commercialisation potential, interviewees Ind4, Gov1 and Gov4 viewed university as incompetent in performing commercialisation compared to the industry. The reason for this is attributed mainly to limited skills, experiences and knowledgeable expertise (i.e. professor, researcher, commercialisation officer) in commercialisation activities. Due to this limitation, interviewee Ind4 recommends university to establish link with industry:

> *"(Some) university has their research and feel they can commercialise their research but the professors there are not the right people to commercialise. They are not business people, that's why university set up entrepreneur arm to help commercialisation but still I don't know if they will succeed. I think if they should collaborate with industry" (Gov1).*

Interviewee Ind4 support this view where it was stated that:

> *"... Lecturers they are not business people. What they need is collaboration with industry. Let the university produce technology and let the industry people to do the marketing. Or they can create joint ventures in some areas. For example let industry come out with the marketing and entrepreneurial concept and plan and the university focusing on research of new technological product*

or services. At the moment it is quite difficult to be entrepreneurial university as it is hard to set up" (Ind4).

The other concern regarding the drive to develop EU voiced by interviewees Uni3, Ind4, Ind6, Fin1 and Gov1 is that universities need to have healthy linkages with the industry not only for R&D but also commercialisation and technology skills. Ind6 view best exemplified this concern:

"It's a long way to go but my advice is university need to be actively involve with industry and also need to prioritise with the quality of the graduates first then think of becoming entrepreneur." (Ind6).

Nevertheless, it was found that some interviewees notably Uni1, Ind4, Ind5, Ind6, Int2 and Gov1 disagree with the concept of EU and suggest Malaysian universities to maintain their traditional role of teaching and research instead. The concept of EU according to them will dilute the quality of teaching, learning and research. Three interviewees feels that it could create problems for university:

"I don't really think university should be go into this entrepreneur university because you are creating another industry within that and not solves the problems and not looking into root or cause of the problems" (Gov1).

"Academician is difficult to be entrepreneur so we have to encourage the university itself. For example in US they have firm sponsoring universities. They sponsor school like business school; they put some input into the school. University Putra is focusing on agriculture and as such should ask Sime Darby to work closely with its school, and then certain researches can be work together rather than they work alone. Then they can bring SME or corporation to provide grant" (Fin2).

"The prime objective of university should be education. This means teaching and for research depends on the level of funding available. This includes the cost of services that could support the continuity of research work. The more focused you are in becoming entrepreneur, the more you will move away from the university's objective and then the university will suffer. This is especially if you are public university" (Uni1).

This section discussed the possibility of Malaysian universities to become Entrepreneurial University (EU). There are three major concerns were raised including the capability of universities to concentrate and focus on research areas that have commercial value, the collaborative relationship culture among researcher in the universities with the industry and the quality of local graduates. The summary perceptions on the possibility of the development of EU in Malaysia based on background of interview respondents were presented in Table 7.4.

University	Industry	Intermediaries	Government
• Not ready but moving towards EU concept (Uni3 and Uni4). • Organisational structure has changed with includes new position of deputy vice chancellor in industry and commercialisation (Uni2). • Need further interaction with industry (Uni3). • Reluctance to commit in becoming academician, researcher and entrepreneur at the same time (Uni3). • Pressure to meet individual's key performance indicator's (KPI) including teaching and produce research paper (Uni3). • Confused on university's priority as whether to produce excellent graduate or becoming enterprise (Uni3). • Uncertain on the concept of research university status and associate the status with prestige, privilege and perceptions (Uni4). • University should not be EU (Uni1)	• Not ready but moving towards EU concept (Ind1, Fin1 and Fin2) • Potential in biotechnology industry (Ind1). • Need further investment in quality of lecturer and researcher i.e. PhD (Ind6 and Fin2). • Need further focus on R&D (Ind1 and Ind2). • Need further focus on quality of graduate (Ind5 and Ind6). • Need further focus on teaching and learning (Int4). • Industry to perform commercialisation and not university (Ind4). • Need further interaction with industry (Ind6 and Fin1). • University's researcher should focus on applied then theoretical type of research (Ind2). • University should not be EU (Ind4, Ind5 and Ind6).	• Not ready but moving towards EU concept (Int4). • There is intention but not capable and still in foundation level (Int1-A). • Changes in organisational structure include commercialisation centre and officer in most local universities (Int1-B, Int3). • Need further focus on R&D (Int2) • Need further focus on teaching and learning (Int2). • Need to motivate students with exposure and participation in competition including entrepreneur activities (Int3). • Associate university's vice chancellor role as a politician (Int3). • University should educate local entrepreneur in fundamental concept of business (Int4). • Unsure on capabilities of officer in commercialisation centre (Int3). • University is lacking of competitive product that could be commercialised (Int3). • University should not be EU (Int2).	• Not ready but moving towards EU concept (Gov1 and Gov3). • Need further focus on R&D (Gov1). • University not capable to perform commercialisation (Gov1 and Gov4). • Conflict in issues of ownership (Gov3). • Lacking of facilities, equipment and expertise (Gov4). • Need further interaction with industry (Gov1). • University should not be EU (Gov1). (Source: author)

Table 7.4: Summary views on readiness and capabilities of university in becoming entrepreneurial university (EU) by interview respondents

7.7 CONCLUSION

This chapter presented and discussed the analyses of the research qualitative data, including presenting a brief discussion of how the data was analysed and segmenting the text data into two main issues. The collection of qualitative data used a face-to-face interview instrument (semi-structured) that consist of 21 interview respondents from overall of 16 different organisations (Table 7.1) includes universities, technology firms, financial institutions, intermediaries, and government agencies. These interview respondents were also representing the triple helix actors in the local innovation system as explained in Section 5.8.1. The collected qualitative data were processed and analysed further, which involved five stages (Figure 7.1) from raw data to interpreting the meaning of data. The influence diagrams were used to visualise the content analysis and the thematic analysis technique was employed with aid from computer-assisted program QSR NVivo10 for robust and systematic text analysis process. A triangulation approach was used to corroborate both findings by cross referencing and linking the qualitative findings in this chapter with quantitative findings (Chapter 6).

The state condition of MSC includes the readiness to become a technology cluster, availability of local technology production, differences of MSC with other clusters and its contribution for public, local infrastructure, resources and local policies development were further explained. The relationship between local system actors (universities, firms, intermediaries and government agencies) in MSC were explored and further explanations were gathered as to why the relationship between universities and firms were discovered to be weak in the quantitative findings. The outcomes indicate that lack of social infrastructure influenced the effectiveness of the collaboration process (i.e. motives and barriers) as the condition of the cluster development determinants were either limited, not ready or even not in existence.

Another interesting issue that emerged was the case of entrepreneurial university (EU), which universities play important role in contributing its knowledge resources for economic development. Major concerns were raised for the progress of entrepreneurial universities, which were: the capability of universities in producing commercial value type of research output, collaborative culture among university's researchers and the institutions, and the quality of teaching and learning for the production of best quality graduates and talents (Table 7.4).

Overall, Figure 7.7 at the end of this chapter is presented to summarise the analyses of the interview findings using an influence diagram and the conceptual framework of this research. This chapter has discussed the state of the MSC including the availability and position of local technology in the market, contributions and comparison of MSC with other international clusters. It then focused on the role of actors and its contribution in the development of the cluster including the challenges that currently restricts collaborative relationship within the MSC cluster. Further discussion is presented in Chapter 8 to explain and justify the outcomes from both findings with related concepts, models, method and approaches, conceptual model and the main research subject (i.e. research question and objectives).

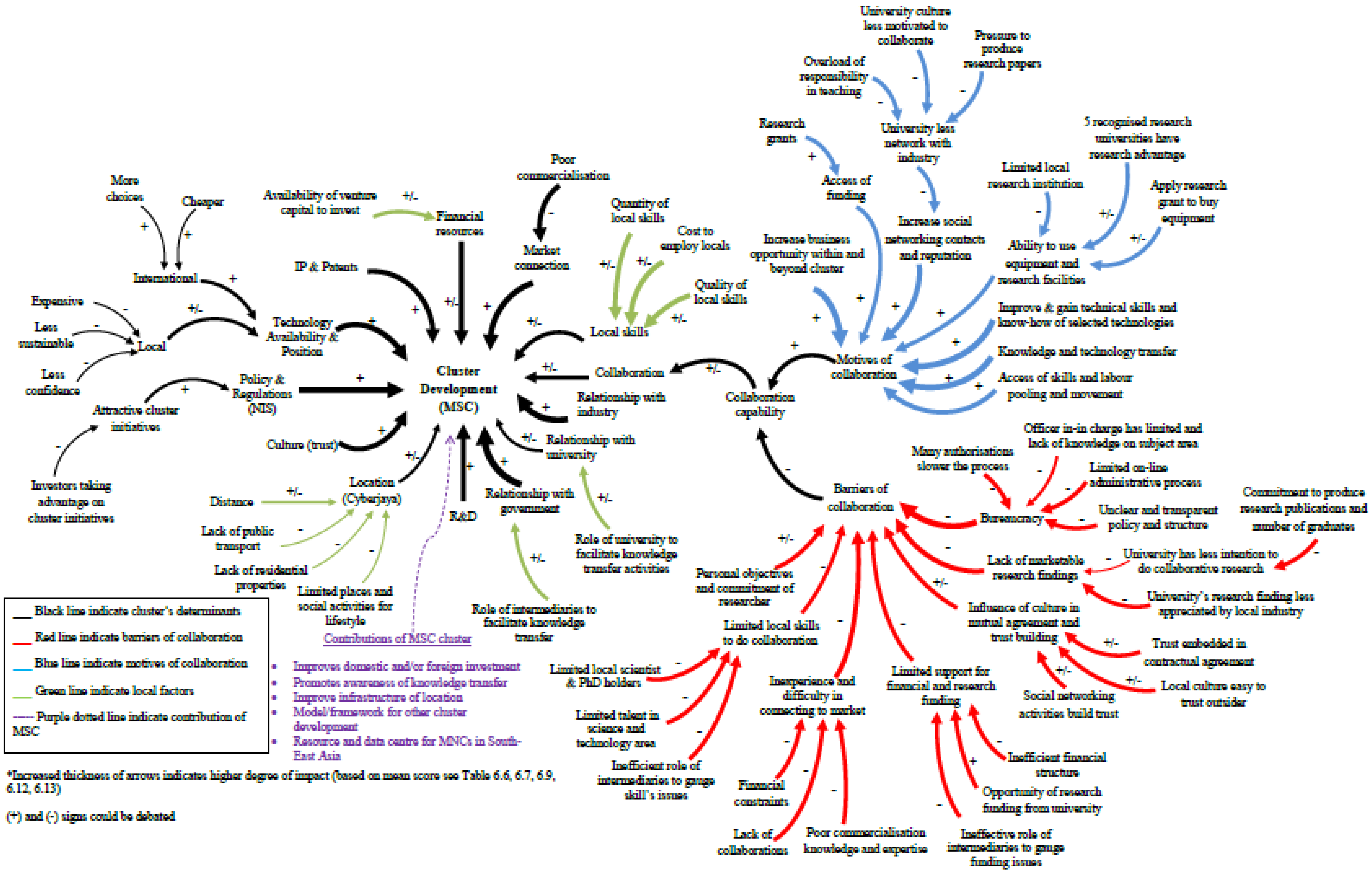


Figure 7.8: Summary of interview survey data analysis based on influence diagram and conceptual model

(Source: author)

CHAPTER 8

DISCUSSION

8.1 Introduction

The main thrust of this final chapter is to answer the research question and objectives by drawing conclusions on the findings from Chapter 6 and 7. In doing this, the outputs from following the methodologies (Chapter 5) are used to analyse and evaluate the evidence to answer each of the research objectives. The meaning of the research output in the MSC context is discussed with the use of relevant literature and the conceptual model (Chapter 2 - 4), thus provides an important perspective to understand the position of the engineered MSC according to a the cluster lifecycle stages (Section 2.3.2), and thus answer the research question. Following from this, suggestions are made for possible future investigations to be undertaken to extend the scope of the work. The overall framework of the research discussion output is illustrated in Figure 8.1.

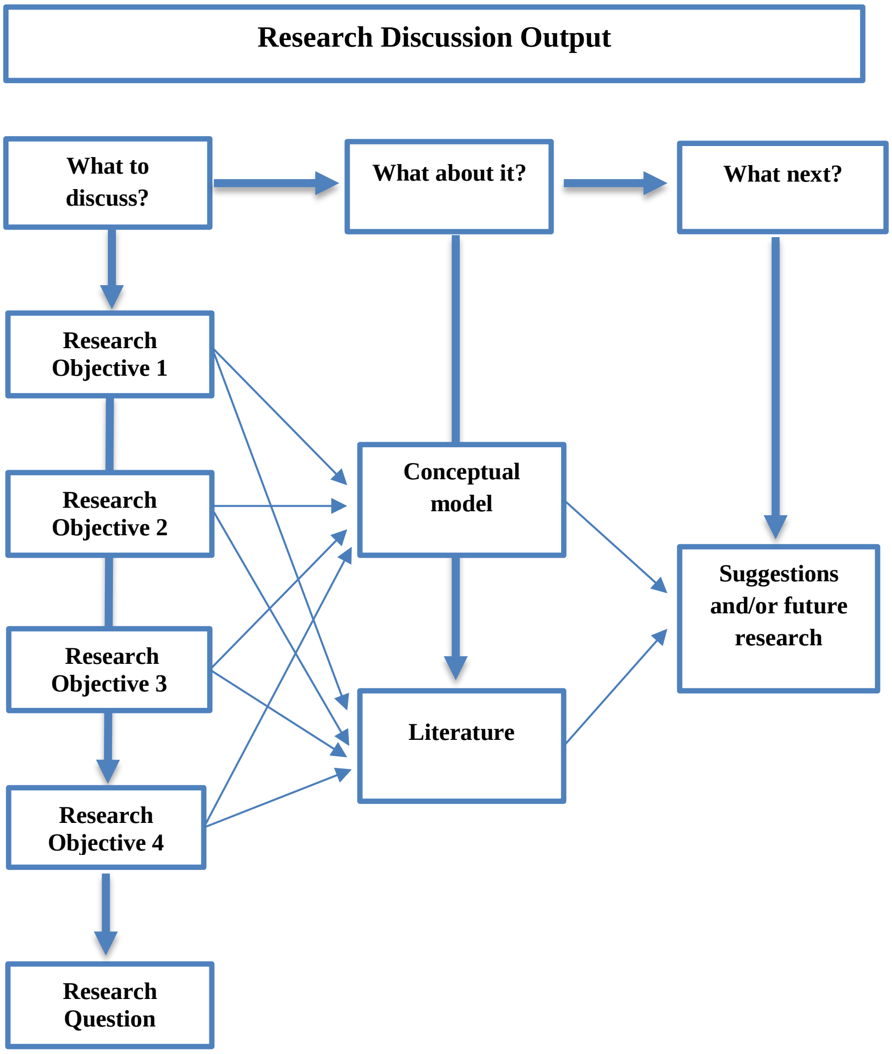


Figure 8.1: Framework of research discussion output (Source: author)

8.2 DETERMINANTS FOR CLUSTER DEVELOPMENT (FIRMS FORMATION)

This section discusses the results of investigating the first research objective:

> *RO1: Explore and investigate the factors (determinants) for the development of a cluster.*

The outcome from this objective was to form the conceptual framework for the other three research objectives, i.e. the conceptual model was developed to guide the investigation of the MSC case study. The determinants (factors) of cluster development were identified from literature on the success stories of cluster formation such as Silicon Valley (US) and Cambridge (UK) (Section 2.3.3). There were eleven significant factors found:

- Close relationship with actors in cluster i.e. universities, industry (firms) and government;
- Local entrepreneurs and local skills;
- Technology availability;
- Local financial support;
- Location;
- R&D activities;
- Connection to market and commercialisation;
- Issues on IP
- Government policy and regulations;
- Local culture including trust; and
- Economic and business environment

These determinants can be categorised as micro and macro factors (Figure 3.9) i.e. factors that can be controlled, or not, by organisations. As explained in Section 3.3, the conceptual model (Figure 8.2) highlights the important role of actors and collaborative relationships to the degree of contribute to firm growth, and consequently development of the cluster (Section 2.3.3). This model has been used throughout the investigation (including the construction of the data collection instruments) and will be used to answer the remaining three research objectives.

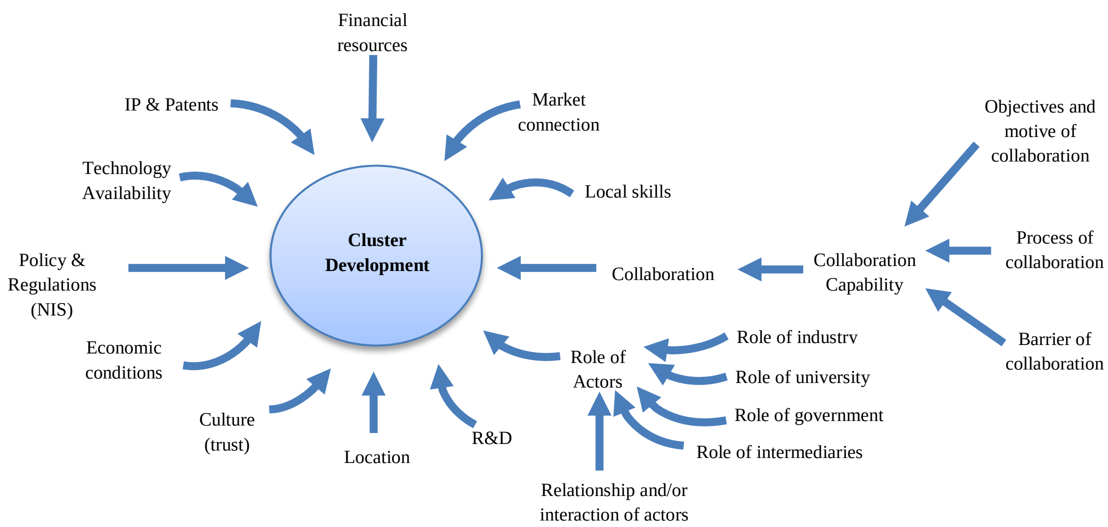


Figure 8.2: The conceptual model in context (Source: author)

8.3 THE ENGINEERED MSC CLUSTER: EMERGENCE AND DEVELOPMENT

This section discusses the results of investigating the second research objective:

> *RO2: Examine the factors that influence firm growth in the cluster: the collaboration effect including motives and barriers.*

The state of the each determinant in the MSC cluster is evaluated. Subsequently, the influence of collaboration (knowledge transfer and use) including motives and barriers in the cluster are discussed and a modified conceptual model is created based on the research findings and analyses. The discussion concludes with the growth conditions for firms in the MSC cluster.

8.3.1 The State of Firm Growth in the MSC

The analyses of the quantitative and qualitative data obtained through the survey and in-depth interviews respectively identified some conditions and challenges for the development of the MSC cluster. These conditions and challenges affect both sets of technology firms (ICT and Biotechnology). The analyses identified highlights the specific characteristics of the cluster, including the emergence and growth of firms, the influence and impact of status recognition and R&D and the impact of local factors and the determinants in supporting the development of the MSC through knowledge sharing activities.

- *Government policy and regulation*

Government policy initiatives and regulations impact small firm formation and growth of existing firms. The cluster initiatives such as the Malaysian Bill of Guarantee (BoG) provide a mechanism to support these firms and/or international firms meeting predetermined criteria qualify for funding and incentives from the Malaysian government. These include unrestricted employment of local and/or international workers, freedom to source fund globally and tax exemption for up to 10 years. The survey found that just over 50% of technology firms received support in the form of status recognition from the government (Table 6.2, Section 6.3) which will enable them to benefit from the BoG; and the majority of them confirmed that the initiatives had a high impact on their business performance and development (Figure 6.2, Section

6.5.1.2). The findings also highlighted the main contributing factors that support firms growth in the MSC are the policy, support and regulations outlined by the government: 90% of survey respondents confirmed this as important for their organisation (Table 6.6, Section 6.5.1.4). Reinforcing this, the interviews found that the attractive policy set by the government has brought international companies to base their operation in the MSC. These operations are mainly outsourced data centres and services for the Asia region for companies such as HSBC, Dell, NTT Corporation and Shell in Cyberjaya.

Sölvell et al (2003) found that cluster initiatives were mostly identified in developed and transition economies such as in Europe, North America and Australia which tend to focus in technology-based industries like in ICT and biotechnology industry. These developed and transitional economies are typified by science and technology innovations promoted as a major part of the government thematic priorities in policy planning. This demonstrates that effective development of a cluster not only in developed economies but also in developing economies such Malaysia, the task of policy advisers become crucial in successfully in developing these initiatives for the country's national innovations system. In the current MSC case, the government policy was also found to influence the firms to collaborate and 64.8% of respondents confirmed it give high impact to their organisation (Table 6.12, Section 6.5.2.1).

In conclusion, the impact of government policy and regulation in the MSC can be considered as "high impact" to the firms as the economic support is still critical at the current state where firms are still heavily subsidised by the government.

- *Connection to market and commercialisation*

Connecting to market and commercialisation of new knowledge is an essential element to boost economic growth and act as a strategic instrument of technology diffusion.

Within the context of the cluster, innovation process delivers specialised values and benefits to customer. Commercialisation presents difficulties particularly for small technology firm to be successful and at this stage SME firms are said to face maximum financial stress (Oakey, Cooper and Biggar; 1993) as funding for commercialisation is limited due to heavy investment in R&D; and a lack of knowledge in handling the marketing and commercialisation activities. This notion is viewed as challenging for technology firms in MSC and thus an important element to support firm growth. This particular notion was indicated by 71.8% of the survey respondents (Table 6.6, Section 6.5.1.4). The interview findings corroborate this. Poor commercialisation knowledge among industry and university's commercialisation officers affect the progress of the firms in the industry as well as in global position (Section 7.3.2). To solve this problem, technology firms use collaboration as a strategic tool to connect themselves to the market aiming to increase business opportunities and social network contacts – survey outcomes: Table 6.12, Section 6.5.2.1; and interview findings: Ind6, Section 7.5.1. The role of intermediaries emerged as bridging consultant (Bessant and Rush, 1995) to support the firms (industry) and knowledge institutions (university) in commercialising their research findings as found in interviews (Table 7.3, Section 7.4). This shows that the role of intermediaries can support firms to progress in marketing and commercialising of new knowledge into the related market and reducing the financial stress of firms at this stage.

In conclusion, the impact condition of connection to market in the MSC is considered "low" because the firms are still in need of support from the government and especially from intermediaries in the commercialisation process.

- *Location*

Geographic economic concentration and location proximity are among the main factors of the cluster concept (Porter, 1990) and firms located within clusters are found to be more likely to innovate compared to those that are not (Baptista and Swann, 1998). This study found that not all firms in the sample indicated that location within this MSC cluster matters in supporting their development with less than 50% of respondents regarding the determinants as important and very important (Table 6.6, Section 6.5.1.4). Among this group, 63% of respondents from biotechnology firms regard location as important for their business as compare to 41.4% of respondents from ICT firms (Table 6.17, Section 6.6.1). This indicates biotechnology firms considered location does contribute towards their performance. This findings contrast with that of Zaheer and George (2004) studies that indicates no evidence was found to suggest location matters for the performance of biotechnology firms in a cluster.

Furthermore, the interview findings suggests that Cyberjaya as the capital city of MSC does not gives high impact to the system actors as the location is struggling with the business and social environment condition, particularly lack of social infrastructure such as residential properties, lifestyle entertainment and services, and transportation (Fin2 and Uni1, Section 7.3.1). Overall, the location factor does not matters to system actors considering the distance to main capital city of Kuala Lumpur is less than an hour and lack of social infrastructure for businesses and living. However there are large foreign firms located in Cyberjaya focusing in ICT industry attracted by policy initiatives such as BoG to foreign firms such as Shell, IBM, HSBC, NTT and DHL in the MSC. They probably found the MSC as a suitable condition for extending their businesses such as in data processing and services, creative multimedia, internet service and network solutions; and reducing the pressure of globalisation such as cost of location i.e. wages, offices rents, land and quality of life.

In conclusion, the impact condition of location in MSC is considered “low” because there is lack of social factor support such as housing, sports centre and local amenities.

- *Intellectual Property*

Intellectual property and patents are critical in managing innovation and protecting the knowledge for firms as well as universities in cluster studies. The survey findings indicates (Table 6.6, Section 6.5.1.4) that 62.5% of respondents acknowledged the importance of IP in supporting technology firms in cluster and 50.0% of respondents were motivated to collaborate to access partner’s IP. Phillips and Ryan (2007) suggests that IP management including the government role and clear policy is important in driving the innovation in cluster and investing in effective mechanism to protect and legally transfer IP across boundaries i.e. locally and internationally before deciding to collaborate with others.

However, this study found that 35.3% of survey respondents considered collaboration in the MSC is constrained by unclear policies for using patents (Table 6.13, Section 6.5.2.2). Furthermore, interview findings found that industry and universities in the MSC have (i) low awareness on the importance of IP and patents on their research findings; (ii) have problems with cost and time for patent applications; (iii) lack active support from intermediaries to assist in the patenting process; (iv) and are hindered by the issue of IP ownership in the university (Int4, Uni4, Ind5, Gov3 and Gov4, Section 7.5.2 (h)). This explains that actors in MSC cluster are not sufficiently benefiting from IP and patents due to limited knowledge of the IP and patent management, financial constraints and lack of support in legal advice on IP policy to adopt for business use. Therefore the MSC cluster actors require further awareness and knowledge of protecting their research findings and inventions; and more concerted practice mechanisms for enhancing effective management and use of IP in the cluster.

In conclusion, the impact condition of IP in the MSC is considered “low” because firms and universities still lack knowledge on the benefits and processes for protecting their ideas.

- *Local skills*

In the MSC, local technology production is considered to be at a low level based on the qualitative findings, and local firms are heavily dependent on using outside (foreign) technology than local (Ind2, Fin1 and Fin2 Section 7.3.2). The failures of local technology production in the MSC are due to expense, lack of sustainability and lack of credibility for use by locals: interview respondents (Ind2, and Fin2, Section 7.3.2). As a result, outside technology is the considered to be the best alternative because it is usually cheaper and there are a range of options to choose from. This has influenced the technology production and position of the MSC in local and global markets.

The local knowledge resource in the MSC is limited in areas of science and technology with a small number of PhD holders (Table 4.3, Section 4.4), local scientists and technology experts (Lai and Yap, 2004; Ind1, Ind4, Gov4, Fin2 and Ind3, Section 7.5.2 (a)). Furthermore, this was one of major problems for firms to collaborate with the universities with 57.9% of survey respondents regarding this as high impact (Table 6.13, Section 6.5.2.2). This suggest that MSC lacks knowledge resources for local technology production and thus requires knowledge enhancing policies to drive improved local performance including investment in local workforce knowledge such as training in targeted science and information technology, and nurturing these skills at the an early stage i.e. school. Also, the MSC requires healthy collaborative relationships among actors to motivate and utilisation what local knowledge resources exist. Oprime et al (2011) affirmed that use of local resources such as human resources and implicit knowledge through integration and inter-firm cooperation is needed for the development of a cluster.

In conclusion, the impact condition of local skills in the MSC was considered to be “low” because firms are still lacking local skills, and in particular the key areas of science and technology. As a consequence, normal practice is to import technology thus reducing the likelihood of firms collaborating with the universities.

- *Relationship*

Oprime et al (2011) found that collaborative relationships and integration stimulates the development of clusters, while Porter (1998) suggests that companies are required to be actively involved and establish a significant local presence to enable them to access resources and work collectively in private sectors to fully benefit from the clustering advantage.

In this study, the survey findings (Table 6.13, Section 6.5.2.2) identified that among all determinants investigated, the social issues which are “interactions and networking with others” emerged as one of the main hindering elements blocking the progress of the MSC and negatively influences the capability of collaboration within the MSC. Industry (technology firms) are less confident in having close collaborative relationships with the university due to the anxiety of difference in the approaches to research; the concept and focus of the research of the university researchers are perceived as being less marketable. While for the university, lecturers and professors delivering a complex range of services in learning and teaching, producing research papers, and concentrating on research projects with government funding. This leads to very limited time for linkage activities, including collaborative networking and research with industry, this blocking the transfer of potentially valuable knowledge (Uni3, Section 7.6). This suggests that the relationships, interactions and collaborations in MSC are not strongly established. Thus require further actively pursued collaboration activities, social networking and efficient roles of intermediaries in supporting and facilitating the bridging activities (Bessant and Rush, 1995) for better interaction and linkages between industry and university in MSC cluster.

In conclusion, the impact condition of relationship in the MSC is considered "very high" with government and "low" with universities.

- *Financial*

Another important element for cluster development is the financial support for business productivity; and products that require sophisticated financial markets to make available capital for private sector, institutions and stakeholders to survive and stay competitive in a cluster. Ruang and Zang (2008; 2009) found that clustering eased financial constraints for new and small companies in China.

In this study, the availability of financial support to MSC firms was assessed as important for technology firms to stay competitive, but the process of financing came as the second highest barrier for collaboration in the MSC cluster (Table 6.13, Section 6.5.2.2) 6). The interview findings (Fin1 and Gov1, Section 7.4.4) found that insufficient related documents and ineffective intermediaries in facilitating access to adequate funding are reasons that delayed the process of financing. Limited support from financial institution including venture capital was reported (Ind1, Section 7.5.2 (d)). The financial is considered to be unfriendly, and some local banks required collateral from firms for loans or business funding to reduced their investment risk. According to the Global Competitiveness Report 2011-2012 (World Economic Forum, 2012), access to financing is the second most problematic factors for doing business in Malaysia and this research supports these findings. Although access to finance, including venture capital financing, is acknowledged as an important element in cluster development there are little literature on the financial structure of clusters i.e. how actors in clusters managed their capital, how financial institution including venture capital (private or public) is used in supporting the cluster and how the actors network for financing.

In conclusion, the impact condition of financing in MSC is considered “moderate”.

- *Culture and trust*

The culture of each cluster is unique and according to Kroeber and Kluckhohn (1952) culture of an entity depends on the predominant values and behaviours of its members and the common history and experiences developed by such values as trust behaviours (social relationships and networks). From the survey findings (Table 6.5, Section 6.5.1.3; Table 6.14, Section 6.5.2.3), the culture in the MSC has issues of trust, regard as one of the important factors that contributes in supporting firms and enabling mechanism for collaboration in the cluster. The development of trust from all respondents is crucial for collaboration in MSC, and especially for acquiring tacit knowledge. Also, trust has been identified as an important prerequisite for developing social relationships including mutual agreement and informal relationships prior to formal collaboration. Mutual trust is earned by establishing informal contacts in the early stage of collaboration and developing long-term relationships that mark the level of reliability among partners. This confirms Nooteboom’s (1996) finding that trust is part of a social phenomenon that makes collaboration possible.

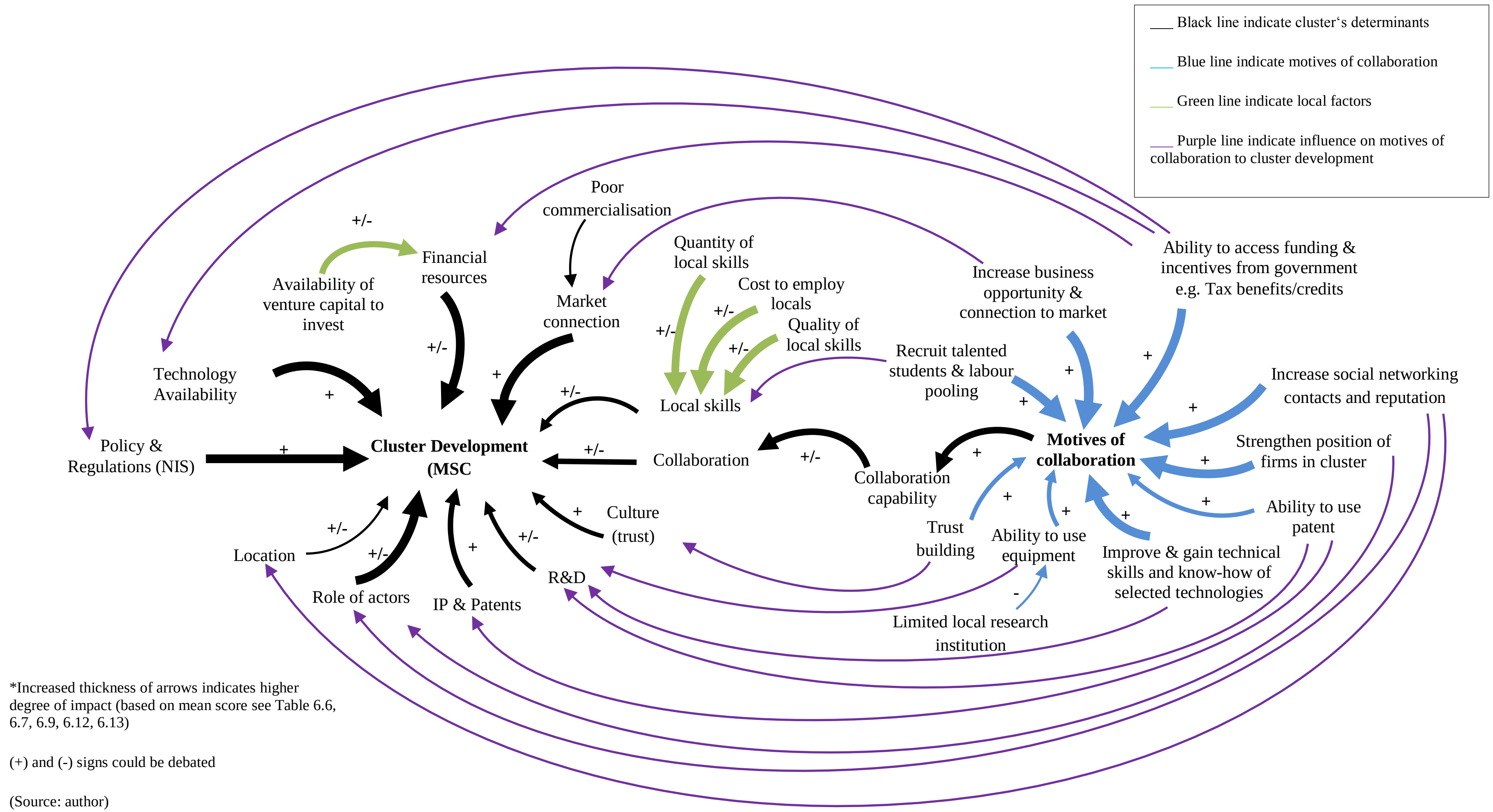
In conclusion, the impact condition of culture and trust in MSC is considered "moderate".

- *Business Idea Formation*

The survey investigated how the technology firms in the MSC cluster emerged by examining the sources of business ideas. The vast majority of technology firms (Figure 6.1, Section 6.5.1.1) developed their business idea independently (knowledge spill-over). The development of business ideas often come into being when the individual (entrepreneur) working for another company and/or institution recognises the possibility and opportunity for setting-up their own establishment. The founder is motivated and has the confidence to start their own company through contacts built with cluster based suppliers and customers, using extensive experiences and knowledge of subject areas relating to the proposed business. Interestingly it was found that firm formation resulted from collaboration either with other companies or institutions. This was supported by the survey findings which found that technology firms use collaboration to increase the possibility of forming new business ventures. The findings showed 61.3% of firms regard collaboration as high impact (Table 6.12, Section 6.5.2.1). This evidence supports the view that collaboration plays an important role as a basis of strategic thinking and formation of new business ideas that may not have been possible acting alone.

8.3.2 Cluster Determinants and Collaboration in the MSC

According to Porter (1998), the determinants of national competitive advantage is dynamic where all determinants interact with each other and the effect of one determinant depends on the situation of the others. This research confirms Porter's claims as well as Miles et al (2000) findings that the role of collaboration capability can enhance the processes of innovation. Both survey and interview findings from this study suggest that the effect of collaboration capability (motives and barrier of collaboration) is dependent on conditions of determinants in the respective clusters i.e. factors contributing to support technology firm growth in MSC as illustrated in Figure 8.3 and Figure 8.4. As indicated in Section 6.5.2.1 and Section 7.5.1, the motives of actors in the MSC for collaboration are related to economic and social reasons. These reasons (Figure 8.3) can each motivate collaboration and can influence and strengthen the determinants within the cluster. The potential for and effectiveness of collaboration activities in the cluster are found to be challenged by the barriers which exist as a result of weak conditions of the cluster determinants (Figure 8.4). It is possible that the role of collaboration as a strategic mechanism could also enhance the cluster development as shown by the collaboration linkages in Figure 8.5. Therefore, the MSC requires active collaboration activities and knowledge spill-over relationship opportunities for its actors. For the institutional actor, this can take the form of more autonomy and flexible reward systems for the university in capitalising their knowledge (motivating more applied and marketable type of research), lowering the bureaucracy system and boundaries, focusing on quality and performance of education system and training in order to support the MSC determinants.

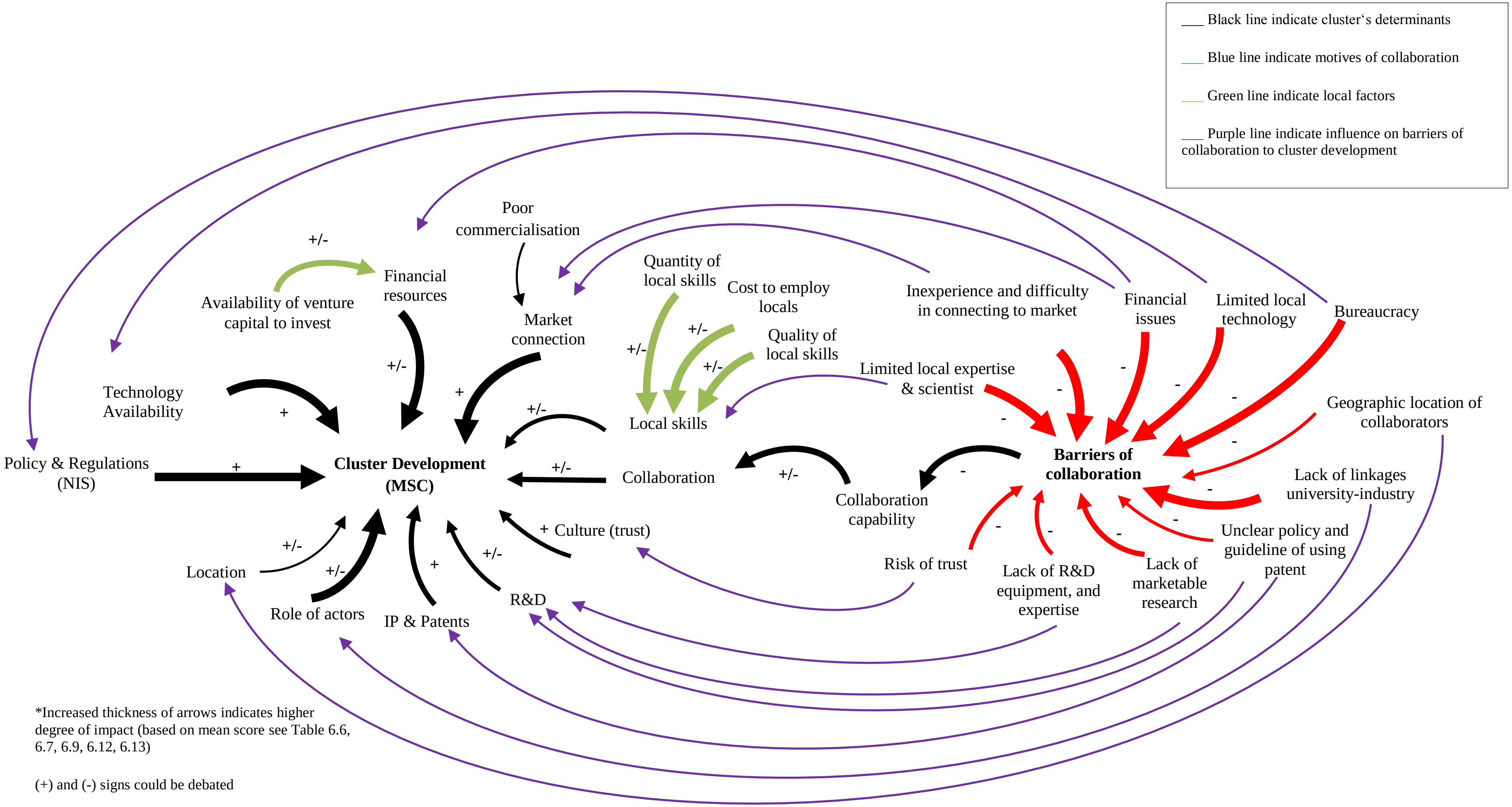


*Increased thickness of arrows indicates higher degree of impact (based on mean score see Table 6.6, 6.7, 6.9, 6.12, 6.13)

(+) and (-) signs could be debated

(Source: author)

Figure 8.3: Influences on motives of collaboration with the determinants of cluster



*Increased thickness of arrows indicates higher degree of impact (based on mean score see Table 6.6, 6.7, 6.9, 6.12, 6.13)

(+) and (-) signs could be debated

(Source: author)

Figure 8.4: Influences on barriers of collaboration with the determinants of cluster

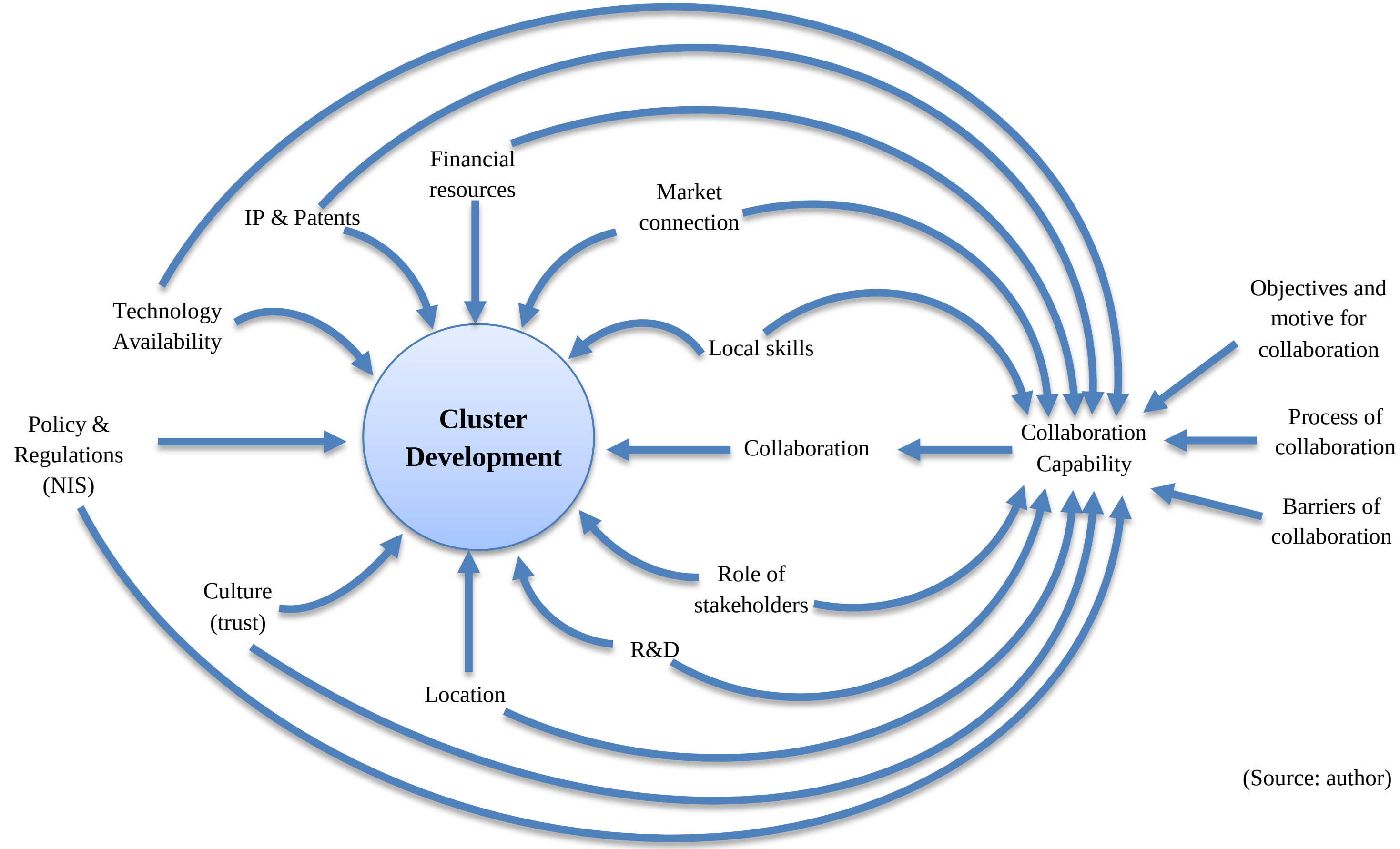


Figure 8.5: Influences on collaboration capability of the MSC Cluster

8.4 The Role of Triple Helix Actors in Cluster

This section will address the third research objective, which is:

> *RO3: Understand the nature and role of university, industry and government; and their relationships on the MSC cluster development*

One of the main determinants concerned in cluster formation in this study is the role of actors and their relationships in the MSC cluster. As suggested from the literature review, each triple helix actor plays a different role in the support of clustering activities, building borderless connections and shaping the identity of the cluster. Analyses from the quantitative and qualitative data found that actors contributed various roles in the development of the MSC and their use of collaboration as a strategic mechanism to perform their roles.

8.4.1 Role of Universities

Technology clusters such as Silicon Valley and Cambridge have shown the significant contributions and involvement of universities in driving their success. In Section 7.4.1 interview data indicated that university play an important role in driving, enhancing and sustaining the cluster as knowledge and technology production centre with the teaching and learning activities on courses offered to graduates and professionals, the R&D and the knowledge sharing activities such as consulting services and conferences. This shows that the universities are maintaining their traditional role of teaching and research typical of the higher education industry. What is more interesting here is that the MSC institutions do not give a high satisfaction level of service to industry, particularly on the quality of courses offered and graduates produced (Fin1, Ind5 and Ind6, Section 7.4.1). This argument is supported by the survey findings indicated that only 25.1% (Table 6.7, Section, 6.5.1.5) of respondents were satisfied with the role of university in facilitating knowledge transfer and sharing activities, while the majority are not. This raises further questions on how effective the universities are in supporting the knowledge and technology transfer for new technology firms.

According to Putnam (1993) strong social capital including networking and trust are mechanisms to strengthen the integration in a region, and helps to enhance the benefits in investment in physical and human capital; underpinning the fundamental concept of an innovation system. In the MSC, both sources of data findings shown that that universities are weak in building, integrating and convening networks with actors in the cluster even though there is acknowledgment in networking for knowledge sharing and technology transfer activities. The survey findings (Table 6.10, Section 6.5.1.6) suggest that industry does not value the university as collaborative partner, with a majority 68.2% of survey respondents believed that it is not relatively important to their organisations. The lack of university capability in social capital of networking to facilitate the coordination and collaboration of triple helix culture could slow the process of the Multimedia University becoming an “Entrepreneurial University” (EU). Interview findings suggest that for Malaysia to create genuine EU’s as it strategic component in developing sustainable innovation, further collaborative linkages with industry is needed to be strengthened. This finding confirms the suggestion from Saad, Zawdie and Malairaja (2008) that there is a need for social capital development in triple helix environment for developing countries such as Malaysia in order to improve its innovation capability.

The role of university in cluster is also seen as a source for talent (skills) and human capital; which includes graduates, researchers and continuous professional development. Both survey and interview findings (Section 6.5.2.1 and 7.5.1) suggest that the motives of industry to have collaborative relationships with a university is to improve the technical skills and know-how of selected technologies as well as to access and select talented students to work with their organisation. This shows that university is contributing towards labour sourcing and pooling in the cluster which gives choice for firms in seeking and recruiting potential human capital to their organisation. This, in turn, reduced the cost of hiring and recruitment selection process of firm.

University was also seen as supporting the entrepreneurship process and activities by providing the equipment and facilities, consulting services and office spaces (incubators) to encourage the spin-off firms that capitalised academic research outputs and technologies. This role affirms Keeble and Wilkinson (2000) view on the role of university as incubators in supporting of formation of new firms and regards as a very important mechanism. 44.3% (Table 6.12, Section 6.5.2.1) of respondents indicate that collaboration with university gave high impact for their organisation because they can use the equipment and research facilities. The interview findings provide further explanation of this action is because there is limited number of local research institution and research facilities that local firms could use. Moreover, interview respondents from the government explained that because of limited local research institutions in Malaysia, most of the applications received for research grants from industry and university in particular is to buy research equipment.

Apart from supporting the entrepreneurship development, problem solving is another role played by university in supporting cluster through the deployment of their expertise, equipment and facilities to assist stakeholders including businesses (industry). This can be done through consulting services either corporate and/or public studies, collaborative research projects and policy setting adviser to government and industry and other activities of university-industry collaboration such as internship and practical training for students. According to interview findings, university is an agent to government by helping in generating, developing and measuring the policy setting; the functions of cluster initiative and act as a catalyst of knowledge and technology transfer agent for government. University also has shown support in government's programme such as collaborating with MDeC in UGRAD[7] (Undergraduate Apprenticeship and Development Programme) and JC-GEMS [8](Job Camp-Graduate Employability Management Scheme) for its students in ICT related subjects during their apprenticeship and industrial training to stimulate the firm formation in the MSC and its neighbouring areas.

The role of university as a source of funding to industry on research related activities in the cluster was also revealed in the interview findings. This financial support and involvement of university in supporting small technology firms is purposely to enhance the linkages between the two actors in the cluster. Through collaborative research activities between university and industry, the government is hoping to nurture indigenous technology as this has been recognised as one of the gaps in local technology production and capabilities in Malaysia. The research universities (RUs) in Malaysia have the opportunity to receive more research funding from the government. This role also associates with the role of university in supporting the entrepreneurial activities in local university.

[7] UGRAD is specifically designed to facilitate high quality and on-the-job training for undergraduates during their apprenticeship or industry attachment. Selected ICT companies with robust internal training programmes will mentor the undergraduates for a minimum period of 12 weeks. Upon completion, UGRAD-SIP trainees have high chances of being absorbed by participating companies. (Source: MSC Malaysia website at http://kdi.mscmalaysia.my/Main.action)

[8] JC-GEMS is a programme collaboration between MDeC and Talent Corporation Malaysia Berhad (TalentCorp). The overall purpose of this programme is to encourage ICT companies to hire fresh graduates and train them according to the needs of the companies. This programme also assist ICT companies in reducing initial cost of training and subsequently, help increases the employability of a fresh graduate.

(Source: MSC Malaysia website at http://kdi.mscmalaysia.my/Main.action)

Both findings (Table 6.12, Section 6.5.2.1; Section 7.5.1) indicate that there are low levels of networking between university and industry, with both actors depending on the government funding and support, thus illustrating the evolution of triple helix in Malaysia is still in the early stage i.e. between statist and lassie fair even though there are signs of moving towards an entrepreneurial concept but slowly. There is lack of confidence of university capability in capitalising on its knowledge by industry and government. In Malaysia universities are considered to be quite young i.e. established for less than 50 years. Thus it can be said that the roles of universities in the MSC are more focused on producing output (papers, graduates etc.) and developing internally rather than committing to transforming the cluster. The possible reason is because there is so much concern from both industry and government on the quality of graduates produced by the university. 78.4% (Table 6.14, Section 6.5.2.3) of survey respondents believed that by improving the quality of the local education system and exposing early industrial training to students could enhance and give high impact for future collaborative activities.

Overall, universities perform an important role in social and economic development in the cluster intentionally or unintentionally. However there is different emphasis and possible explanations of the role performed are related to the characteristics of the university including its organisational factors such as culture, leadership, structure, management style and motivation; the policy setting and the characteristic of the cluster itself. Furthermore the role of university in the MSC is seen as generating and supporting the development of cluster rather than transforming it leaves it far behind the hybrid type of helix.

8.4.2 Role of Industry (Firms)

Entrepreneurs and small and large firms contribute the factor of production in an industry cluster and serve the local market in many ways, such as manufacturing, supplying and producing product and/or services. There is no doubt that the role of industry is vital in generating economic growth in its cluster and nation. The descriptive analysis indicates that having close relationship with industry is important for technology firms in supporting its development in cluster. The interview data (Fin1, Gov3, Section 7.4.2) and indicates that the industry is more comfortable having close links with its industry's members and government agencies rather than with a university. The reason for this is because local firms are less confident with the research done by a university which is more incline to a theoretical approach rather than a market approach. The interview data also noted that *"university is not really active to collaborate"* is because the research done are mainly for "*research publications"* and *"not for the result and value-added that can be commercialised"*. Furthermore, there is lack of local expertise and scientist that working in the areas of science and technology.

According to Oakey (2007), the advantage of cluster concept is that it enables the attraction of local labour supply and this also found in this research. The survey data (Table 6.12, Section 6.5.2.1) suggested that one of the motives of firms to do collaboration in cluster is to attract the desired graduates to work in their organisation. While interview data suggested that having close relationship with industry is helping in *"hiring foreign trained graduates [locals graduated from foreign universities]"* that works with international MNCs because these graduates is said *"are able to understand our [firm] needs compare to local ones"*. Thus firms in MSC shows their role in labour pooling, access to generic qualified labour and reduces the transaction cost in seeking and hiring skills for firms in cluster. This supported with van Winden et al (2004) claims that the role of firms contributed toward the pool of skilled labour from other cities in their research on the development of ICT cluster in European cities and the advantage of cluster concept by Porter (1998).

Over 15 years since its inception, the MSC has been attracting FDI to Malaysia in area of ICT and biotechnology. For example, Cyberjaya is now home to MNCs such as Shell, IBM, HSBC, Nippon, Huawei and Tata operating their business for the Asian market. The existence and involvement of these firms in the MSC has motivated local firms to be more competitive. The interview finding (Ind6, Section 7.4.2) suggest that it is important to have close relationship and actively involved in social networking activities with their counterparts. One interviewee described the importance of this relationship as:

> *"It motivates and increase our [firm's] competition level* and stimulate the firms *to work harder than your [their] counterparts".*

This shows that firms are motivated by others success with the advantage of close proximity to concentrations of customers and rivalry. This findings (Ind6, Section 7.4.2) further supports Porter's (1998) claims on the concept of cluster that motivates local competition and increase the productivity of the firms in the areas. Thus the role of firms (industry) in the cluster is seen as a motivator to pressure other firms to increase their innovation productivity and performance.

Industry also performs the same role as university in providing solutions to government and providing support and advice for policy setting on cluster development. The interview findings (Ind1, Section 7.4.2) explained that industry as an agent to government by participate as scientific advisor and/or committee, respondents for corporate studies, board members of selected industrials agencies and associations.

Furthermore, the involvement of firms in collaborative activities with universities and government agencies such as the internship program, business exhibition and research joint project are encouraging and supporting the process of knowledge (explicit and tacit) transfer which benefits to all participating actors. The university benefit to further enhance their students and graduates in experiencing the early taste of employment environment and learning new skills such as softs-skills (communication, writing and presentation) or technical skills (computer application and lab testing). University also has opportunities to have *"business matching"* with the industry so that university "*can push [their] product forward"* in the market as explained by interview respondents. On the other hand, firms that locate near to university or in university's incubators, benefits to seek advice from the academic research group and experts, using the facilities and equipment, recruits potential students, researcher and experts, and most importantly become the first to know the new discoveries of commercial related findings. This further transforms the social relationship (Etzkowitz, 2008), reliability of trust and informal to formal knowledge which later contributes towards the early stage of firm development as noted by Schumpter (1942) along with support from government and availability of local resources,. This suggest that firms in cluster contributes in knowledge transfer process, provides basic training to young locals (students) and sharing knowledge resources to meet firms need as well as universities and agent of economic mechanism for government in regenerate the source of technology and knowledge-based productivity.

Overall, the role of industry is seen important in generating the economic growth of the cluster (MSC) including the labour pooling, agent to university and government, motivator for competition, and yet to produce competitive indigenous technology in local and global production. The local technology firms requires to upgrading their technological innovation process, initiate innovative projects and utilising the local resource combine with knowledge-based capacity including experts from other firms, universities and institution in cluster. This leaves an opportunity to investigate for future research on the impact of cluster and collaborative relationship in producing indigenous technology.

8.4.3 Role of Government

Etzkowitz (2008) suggests that in the evolution of triple helix firm formation begins with the role of government in directing universities and industry through its policy and later changes from top-down to bottom-up initiatives which the three spheres interact among themselves and each of them starts to perform the role of others (from statist, laissez-faire to hybrid type of helix). The important role of government is also recognised by both respondents from survey and interview of this research. From survey and interview findings (Section 6.5.1.4 and 7.4.3), the role of government is regarded as the most important factor for firms in the MSC through the innovation policies and initiatives programmes for both industry and university. Firms believe that there are several advantages of having close ties with government. These includes supporting firms to *"start business at any time", "easy access"* of information "*from important people"*, "*understand us [the firm's problems] better"* and aware of *"what problem that we [the firms] are facing"*. Government also benefits from this relationship as it helps the policy makers in understanding better the firm's difficulties to progress in their competitive market when proposing new policy framework in national or regional innovation system. This notion placed government as the main contributing factors of MSC cluster development where university and industry are both heavily depends on government support. According to survey findings, the technology firms in MSC valued government as the most collaborating partner in triple helix setting and also confirmed by the interview findings. Thus, the position of the MSC can be categorised as in a statist type of helix with the intention to transit to laissez-faire as there is evidence of industry and university involvement and the role played as agent to government by participation as scientific advisor and/or committee members, respondents for corporate studies, board members of selected industrials agencies and associations (Figure 8.6). This also confirms the research findings by Razak and Saad (2007) on the position of the Malaysia in the triple helix framework.

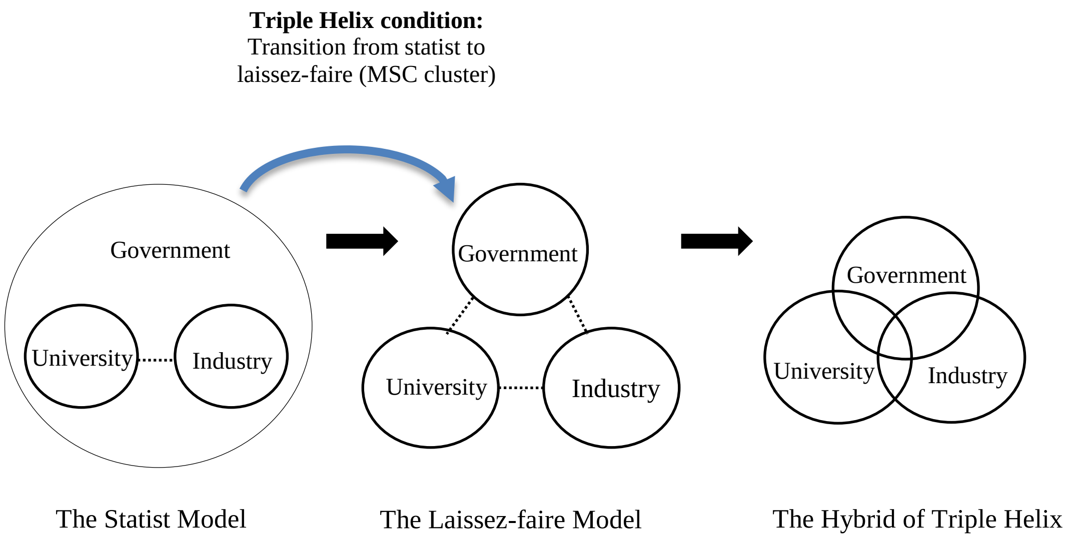


Figure 8.6: Positioning MSC in the Triple Helix condition (Source: author)

Porter (1998) admits that developing nations facing challenging task in improving its national capabilities (determinants of national "diamond" model) in order to compete with the competitive develop nations. He further suggest for developing countries to invest in local factor such as the modern infrastructure, the education, information and communication facilities and local talent in science and technology as the first priorities. This means that the role of Malaysian government is important in providing enabling and conducive policy framework and environment for the success of cluster. The interview findings acknowledge that *"the government role is to provide the environment"* so that the triple helix actors are able to do their job. Based on survey findings (Table 6.7, Section 6.5.1.5), the technology firms are satisfied with the current local factors such as the cost to employ locals, internet and communication system, but not the transportation, health care services and the role of institution for knowledge transfer activities that need further progress for enabling environment in the cluster development.

As mentioned in Section 7.3.3, the interview findings (Fin2, Gov1 and Gov2) suggests that the role of government is to connect the industry and university with the appropriate market along with the help from supporting organisations (intermediaries) that working for government. The involvement of supporting organisations such as MDeC, MATRADE, MIDA, Biotech Corp and SME Corporation in the development of MSC also shows the devolution of central government. These specific organisations focusing and responsible in specific policies mandate by the government to achieve specific capabilities such as nurturing local technology production, promoting healthy relationship among system actors, commercialisation issues and funding through cooperation and collaborative projects. It is difficult for government alone to monitor the effectiveness of priorities and policies from distance; and the role of intermediaries come in handy to help the central government. As noted by one interviewee:

> *"the role of agencies such as MDeC and MATRADE [is] to integrate [relationship] between university and industry* and *"their influence can bring university and industry working together and share knowledge and cost"*.

This affirms Oprime et al (2011) claims that the role of government and supporting institution such as intermediaries are needed and important for stimulating cooperation inside the cluster and Smedlund (2005) on connecting the national, regional and local priorities.

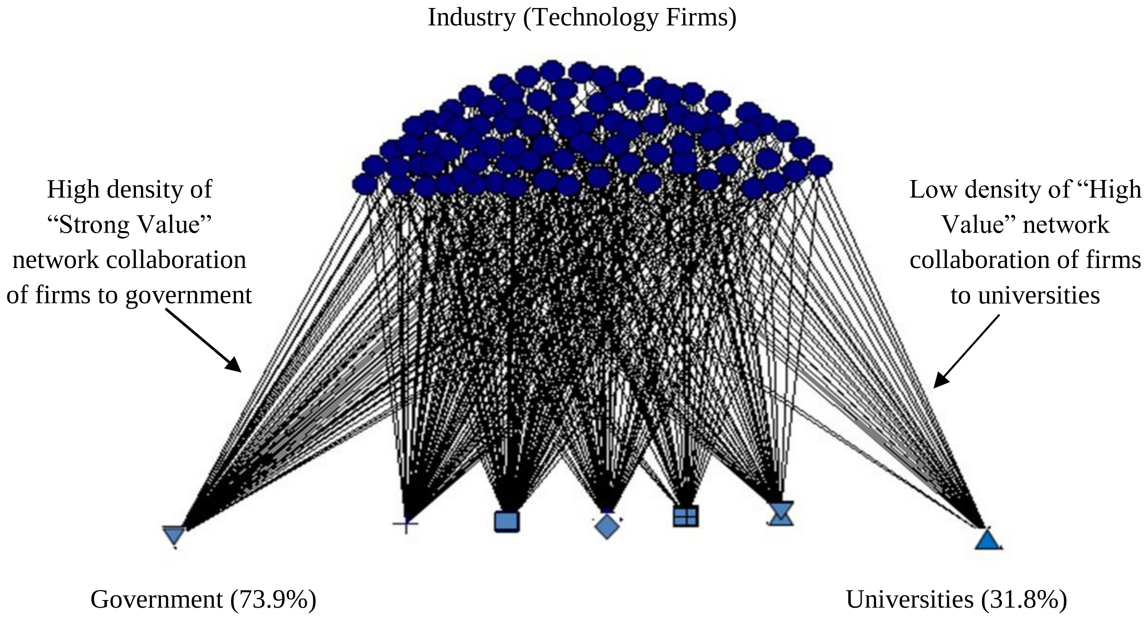
In conclusion, the role of government in the engineered cluster of MSC is important, not just in providing an economic environment, including local resources and policy initiatives, but also connectors for industry and university to foster collaborative relationship. Although, there are changes in the university approach towards the evolution of Entrepreneurial University and industry involvement with university in collaborative research activities; the role of government still maintain as the dominant position in MSC. The role of the Malaysian government becomes more challenging in reducing the "red tape" to attract tacit technology knowledge and learning capacities for the local economies as these were found to be barriers to effective collaboration in MSC. This needs innovative policies that fit the needs of the current economic development as suggest by Porter (1998) that *"government policy must evolve so as to anticipate the needs of an upgrading economy"*. To do so, more investment in the MSC and other similar cluster initiatives are needed for future economic transformation. It seems that the vision of becoming a developed nation by 2020 will be impossible to achieve within the remaining 7 years but perhaps possible in the next 20 years when the cluster is at the peak of its life cycle.

8.4.4 Actors relationship in MSC

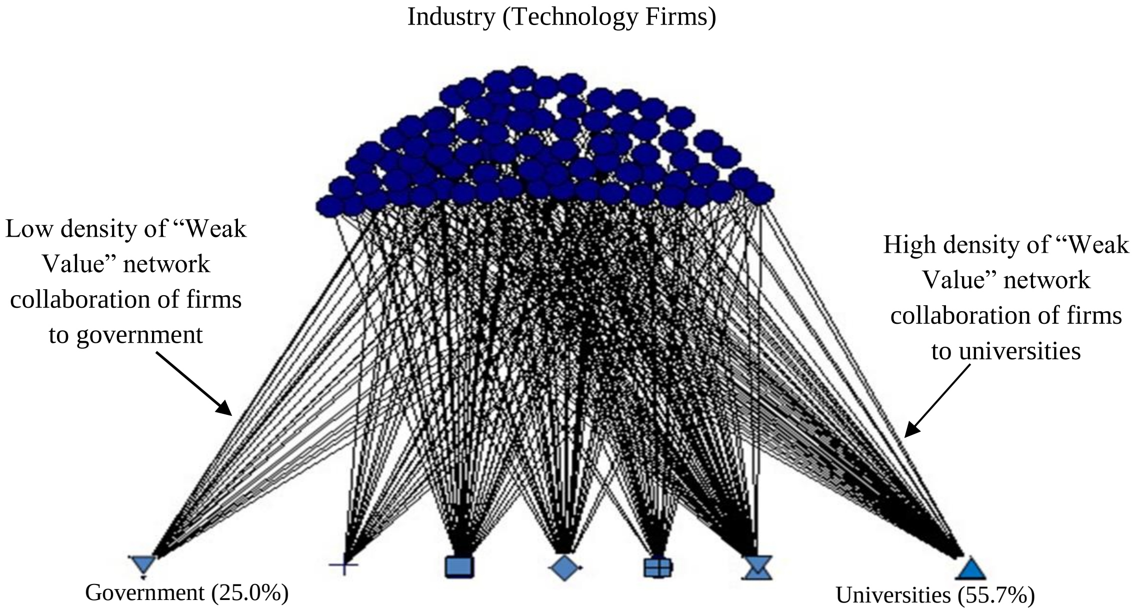
The previous discussion on the roles of actors in the MSC provides an indication on their relationship with other. The survey findings (Table 6.10, Section 6.5.1.6) indicated that technology firms (ICT and Biotech) valued their collaborative relationship with government more than research institutions and intermediaries with universities as the least valued partner. Also, having close relationship with other technology firms and government are both more important than having close relationship with university as was found in this research (Table 6.6, Section 6.5.1.4). This evidence were made clear through the network drawing and illustrated from the Triple Helix's perspective as indicated in Figure 8.7.

Explaining to these situations, the interview findings found that the low connections with university were due to the incapability of university to produce high quality graduates (Fin1 and Ind5, Section 7.4.1), less concentrated on applied and marketable type of research (Ind6, Section 7.4.1) and less involve in connection with other (Fin2 and Int3, Section 7.4.1). Universities responded to this, and claimed that they are still depends on government direction on policies that were made unclear to them (Uni3, Section 7.4.1) and received less support from industry as they look down on local research idea (Uni1, Section 7.5.2 (b)).

In conclusion, the impact of actors' relationship in MSC: Very High (Close relationship with government), Moderate (Close relationship with industry), Low (Close relationship with university).



"Strong Value" of network collaboration in MSC: High density (government), Low density (university) based on mean score of value of collaborators in cluster (Table 6.11 and Figure 6.3)



"Weak Value" of network collaboration in MSC: High density (university), Low density (government) based on mean score of value of collaborators in cluster (Table 6.11 and Figure 6.4)

(Source: author)

Figure 8.7: Density of network collaboration in MSC based on "Strong Value" and "Weak Value" impact on type of actor

8.5 Differentiating Engineered MSC with Other Cluster

This section will discuss and answer the fourth research objective.

> *RO4: Identify the primary determinant conditions that make the MSC cluster different from organically formed clusters.*

To address this objective the outcomes from RO1, RO2 and RO3 were to develop a structured a comparison between the MSC and successful clusters. Three primary dimensions were considered to be of structural significance: (i) Government Policy and Regulations, (ii) Economic Condition and Environment, and (iii) Location (green field). The other determinants reflect the stage of the MSC as a transition cluster.

(i) Government Policy and Regulations

Why does the MSC differ from successful clusters? This is one of key questions to be addressed in this research. In Section 6.5.1.4 and 7.3.3, the survey and interview findings found that the role of national policies has a great influence on the development of the MSC and the government remains the dominant power in driving the MSC forward. An interviewee in this study noted that:

> *"the government policy favours investors to come and invest in Malaysia"(Ind6).*

This according to the interviewee has attracted foreign firms such as IBM, Shell and HSBC to locate their operation in Malaysia including the MSC, Iskandar Corridor and Northern Corridor as a base for their expansion into the Asian market. According to the World Economic Competitive Index (2012), Malaysia was placed 12th out of 142 countries in the world as the most competitive location for ease of rules for FDI business. This supports the commitment and intervention of central government in organising and leading the transition effort towards high technology and knowledge-based economic development, similar to the role played by the US and the UK governments for more than 30 years with respect to Silicon Valley and Cambridge (Etzkowitz, 2008; Indergaard, 2003; Porter, 1990 and 1998; Saxenian, 1985). Malaysia is in transition at the moment and this requires efficient economic and technology transformation programmes to catch up, even though it is unlikely to repeat the same success as commented by Saxenian (1985), but one of the main determinants to drive this transition is in place. The promotion of a neo-liberal state framework in Malaysian manifest by policies such as the Vision 2020 programme embodies a national motivation and represents a policy driver which is difficult to change. Thus the development of the MSC has enough inertia to continuously carry forward under the leadership of three different prime ministers. It started when Mahathir Muhammad (4th Prime Minister from year 1981-2003) launched the project in 1996, then continues with Ahmad Badawi (5th Prime Minister from year 2003-2009) and now Najib Tun Razak (6th Prime Minister from year 2009 - now). On another note, the supportive government policy maintains align with the Vision 2020 even though in the latest general election held in May 2013 the current coalition government, National Front (formerly Alliance Party) received simple majority, which is the lowest win since the first election in 1954 to continue ruling the government. The development of the MSC cluster is also facing more local competition with other regional developments in Malaysia such as the Iskandar Malaysia (formerly known as Iskandar Regional Development) and the Northern Corridor Economic Region.

(ii) Economic Condition and Environment

Over the years, the development of the MSC has received investment to continuously develop and upgrade its infrastructure. According to World Economic Competitive Index (2012), Malaysia was placed 26th as the most competitive location on based on basic requirement of infrastructure. The MSC which is a 750 sq. km area has the largest scale digital and fibre optic technology grid providing a high capacity of local and global telecommunication networks. According to the survey findings (Table 6.7, Section 6.5.1.5), 80% of respondents were satisfied with the telecommunication system in the MSC. This expansion and progress of local telecommunication system was under responsibility of Telekom Malaysia Berhad since the successful privatisation of Telecommunications Department in 1984 and has its own university named Multimedia University (the first private university in Malaysia) one located in Cyberjaya (within MSC) and one in Melaka (150km apart from each other). The existence of the Multimedia University since July 1999 in Cyberjaya was modelled on the relationships of Stanford University with the US Defence Department in Silicon Valley, US. The main difference was the attempt to manage the alignment of the university with the MSC as part of a planned institutional driver in the Triple Helix mould (an Entrepreneurial University - three mission university). It also contributed to other determinants in the cluster, specifically the development from a green field to a mature location and was under supervision on MDEC as agent and project manager to government on its development; while Stanford University was well established in the area since 1891 and part of the history of the location.

Furthermore, there are strong relationships between the university, government and local firms in Cambridge and Silicon Valley (Porter, 1998; Bresnahan et al, 2001; Etzkowitz, 2008); while in the MSC, relationships among the main triple helix actors is still weak. This was found in the survey findings (Table 6.6, Section 6.5.1.4) indicating that only 37% of survey firms valued their close relationship with universities as important, compare with government and industry both with 78% and 76% respectively. This shows that the MSC cluster is still at the early stage of its development and according to Etzkowitz's (2008) concept of Triple Helix relationships; the MSC indicators position the cluster in the transition process from the statist to lassie fair phase of the helix formation.

Due to the weak role stance of the universities, the role of consultants played by intermediaries (e.g. MDEC) becomes crucial to attract highly skilled individuals and/or organisations and creating the environment that can manoeuvre local spin off and champions. This is a challenging role to ensure that MSC is progressing with the targeted mission i.e. Vision 2020. Thus the role of intermediaries could be more important than that of universities at the current stage of the MSC development.

(iii) Location

The main city of the MSC, Cyberjaya, is equipped with incubators, multinationals, local private universities; schools, a recreation park and residential areas however there are large swings in the population from day to night, from just over 50,000 to 10,000 respectively. This is due to close distance between Cyberjaya and Kuala Lumpur (less than 50km). Interviewees (Uni1 and Fin2, Section 7.3.1) in this research indicated that:

> *Cyberjaya is far from city life and working vision", "there is not much we could do in Cyberjaya even though it is improving"(Uni1)".* And:
>
> "*people still like Kuala Lumpur rather than Cyberjaya"(Fin2)*.

This suggests that the infrastructure in the MSC has attracted many local and MNCs to locate within the area. Their workforce come mainly for the employment but the area still lacks a social dimension from when it was first planned. This lack of provision and attractiveness for socialisation and living is in stark contrast to the conditions prevalent in successful clusters, where a mature social fabric underpins a high density of knowledge spill-over opportunities.

Conclusion

In conclusion, the policy and incentives set by the Malaysian government along with high quality infrastructure and role of intermediaries in facilitating and promoting the location provides an attractive prospect for international investment, backed by a an environment of a political stability country. However, these apparent strengths of the region are indicative of the overall weaknesses of the other determinants of cluster development (Section 6.5.1.4). It is unlikely that the MSC will achieve similar success to Cambridge or Silicon Valley in the near or medium future.

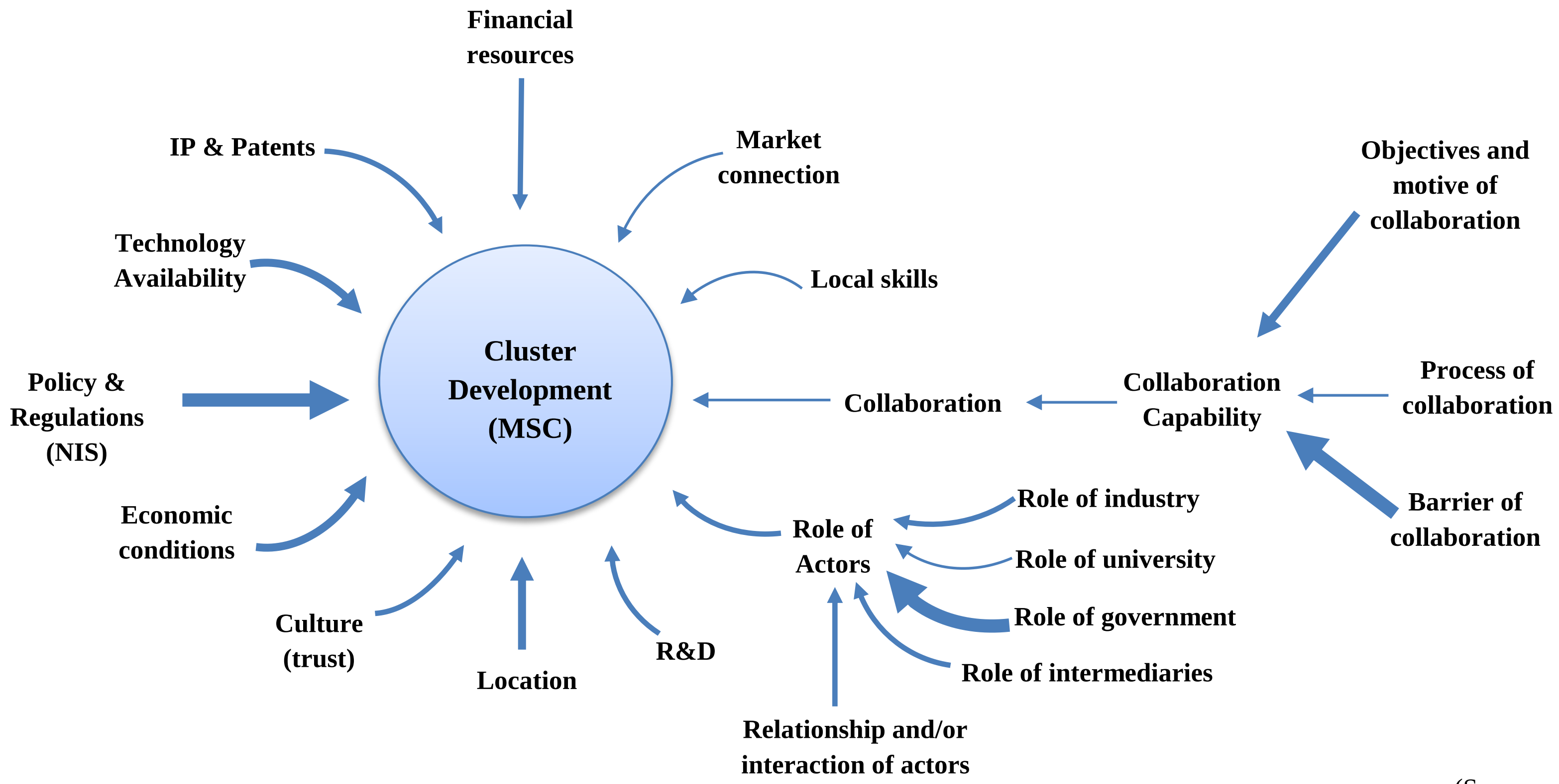
The strengths in the MSC are appropriate for the transition challenges to move the cluster forward, with the support from government and intermediate agencies continuing to invest in infrastructure and facilitate more complex collaborations between the actors in the cluster. There are distinct lessons to be learned from the current work to achieve this – in particular concentrate on creating a more appropriate social space to enhance the social interactions among the system actors (increase knowledge spill-over opportunities).

8.6 POSITIONING MSC IN CLUSTER LIFECYCLE: ANSWERING THE RESEARCH QUESTION

The literature review (Chapter 2, 3 and 4), conceptual model (Figure 3.11), primary quantitative and qualitative data (Chapter 6 and Chapter 7), secondary data (Chapter 4) and discussion on research objectives (Section 8.2 8.3, 8.4 and 8.5) provides evidence to address the ultimate research question for this study, which is:

> *"What are the factors and institutional collaboration determinants for successful cluster development and how do they fit the engineered MSC Cluster?"*

It was found that the engineered MSC has progressed since it was first launched in 1996, with the Malaysian government continuing to put money into local and international project investments. The tertiary education attainment level in the labour force has almost double (Table 4.1) in the past ten years, aided by the growing number of universities in Malaysia (Table 4.4). In the context of MSC, it was identified that each of its determinants has different impact on its condition towards the development of high technology cluster (Figure 8.8). The role of government was found to be dominant for the continued development of the MSC, followed by the role of technology firms, and finally, with less effect the role played by the universities. The use of collaboration as a strategic mechanism of enhancing innovation through business and social interaction between actors was found to be less effective due to the motives and barriers present in the current collaboration process. This research also found that the effectiveness of collaboration also depends on the conditions of the cluster determinants, and in particular the provision of social dimensions which are not emphasised in either Porter's Diamond Model or the Triple Helix Model.



(Source: author)

Figure 8.8: Weighted impact of the MSC's determinants with roles of actors and collaboration (width of arrow indicates strength of the factor)

Using the metrics (impact condition) of the MSC's determinants from the conceptual model (Figure 8.2), the position of the MSC in the cluster lifecycle model can be identified. By comparing with the stages of the cluster lifecycle model (Table 8.1), which was developed based on a conceptual understanding of cluster development from the literature (Section 2.3), the engineered cluster of the MSC can be categorized as in an "emergence" phase. This is primarily due to dependence of firms and universities on direction from central government for orientation and support of the collaboration activities. Although, from the survey and interview findings the university and industry roles are changing but the role of government remains the same, having a very high impact on them. Contradicting the general concept of a cluster dynamic, the factors of location were considered generally "low impact" to the actors (important for Biotechnology firms) as there was incomplete provision of social infrastructure such as housing, transportation, sports and fitness centres etc.

This research opens the potential for cross-sectional studies using the template of the lifecycle model (Table 8.1), and the research approach adopted for the current work, to investigate other clusters in different regions or countries with similar industry profiles i.e. high technology industry. This would increase the number of cases studied and can be used as strategic framework for policy makers in developing nation in particular to evaluate, develop or monitor the outcomes of their cluster engineering efforts in the pursuit of technological progress.

Determinants	MSC Impact Condition	Stages or Phase of Cluster Lifecycle				
		Emergence	**Growth**	**Sustainment**	**Decline**	**Maturity**
Close relationship/collaboration with government	Very High	Very High	High	Low	High	Very High
Close relationship/collaboration with industry	Moderate	Low	Moderate	Very High	High	Moderate
Close relationship/collaboration with university	Low	Low	Moderate	High	Very High	High
Local entrepreneurs and skills	Low	Low	High	Very High	High	Moderate
Financial support	High	Low	High	Low	High	High
Location	Low	Moderate	Very High	High	Moderate	Low
Technology availability	Low	Low	High	Very High	High	Moderate
IP	Moderate	Low	Moderate	High	Very High	High
Connection to market and commercialisation	Low	Low	High	Very High	High	Moderate
R&D	Moderate	Moderate	High	Very High	High	Moderate
Government policy and regulations	Very High	High	Very High	Moderate	High	Very High
Culture and trust	Moderate	Low	Moderate	High	Very High	Moderate
Economic condition and environment	Low	Low	High	Very High	High	Moderate
Role of government	Very High	Very High	High	Low	Very High	High
Role of university	Low	Low	Moderate	Very High	High	Moderate
Role of firms (industry)	Moderate	Moderate	Very High	Moderate	Moderate	Low

Table 8.1: Impact condition of the MSC's determinants compared to the cluster lifecycle model (Source: author)

In planning to evolve to the next phase of the cluster lifecycle i.e. the "growth" stage, the MSC requires improvement in the business and social inter-organisation linkages between universities, industries and government by:

- reducing some bureaucracy boundaries;
- investing in local talents with promotion of science and technology courses in universities (this was found lacking with high unemployed graduates in business and administration as shown in Figure 4.5);

- encouraging local professionals such as scientist and engineers to stay in the country (low number of PhD students as shown in Table 4.3);
- giving more autonomy to universities not only for Research Universities Status;
- efficient roles for intermediaries to bridge the gap between universities and industries by facilitating:
    i. technology-transfer,
    ii. commercialisation process,
    iii. business operation
    iv. financial,
    v. IP support
    vi. promoting collaborative research projects;
    vii. encouraging universities and research institution focusing in R&D that has commercial value and applied application.

8.7 CAN A CLUSTER BE ENGINEERED? LESSONS FROM THE MSC

This research has explored and identified the state of the MSC as an engineered cluster following the adaptation of classic cluster concepts of successful technology clusters from Silicon Valley to transform Malaysia into a knowledge-based economic nation planned to achieve develop nation status by year 2020. The research uses the triple helix collaborative relationship among university, industry and government as one of the guiding frameworks to investigate the conditions of the MSC, along with the key cluster's determinants in the conceptual model. This research obviously has implications for cluster development in general - the main point of the research questions of this study.

The previous sections (Section 8.2, 8.3, 8.4 and 8.5) have answered the research objectives and discovered that the determinants of cluster development react in a positive and dynamic way with the collaboration capability as well as the roles play by the university, industry and government. The research outcomes not only benefits from answering the research question and objectives of this particular study but also contributes to the development of the theories of the cluster concept and triple helix approach to managing innovation.

The theories of Porter's Diamond Model and Triple Helix emphasise the influence and importance of strong relationship or linkages between actors for innovation (which were found to be a weakness in MSC). This weakness is not only because the MSC employs a top-down rather than bottom-up strategic development sequence but due to the lack of provision of social infrastructure as part of social dimension in the cluster space. Interview respondents confirmed that there is nothing interesting to do in Cyberjaya apart from working, this results in a massive swing of population between the day and night as discussed in (Section 8.4). Neither of the foundation concepts (Porter's cluster and triple helix) emphasise the importance of social dimension of effective social infrastructure for enhancing the linkages among actors in a cluster. This research has found that the weakness in interaction between university and industry not only because of the limited skills, value of research activities, commercialisation difficulties, financial stress, collaboration activities and bureaucracy; but also the limited social infrastructure and services. Thus, the MSC actors have fewer social bonding spaces and opportunities that can enhance the social interaction and knowledge spill-overs among the communities involved in the MSC. The initial planning of the MSC project has neglected the importance of this aspect of social dimension for the MSC communities to interact and socialise. Clearly, the more that in known about the impact of the determinants for cluster development the greater the likelihood that engineered clusters will be successful - not only the developing countries, generally. A more comprehensive approach can be devised if cluster engineers and policy designers are aware of the soft determinants that can nurture and produce collaboration as well as the easier to measure and tangible factor conditions such as infrastructure and technology.

The social dimension in cluster building should not be ignored i.e. university, industry and government agency knowledge is in the heads of their employees, and knowledge transfers are matters that contribute significantly to the innovative capability and economic transformation within the cluster. This social dimension not only includes the pattern or structure of the connections, type of relationship between actors and common understanding, but also the provision of social infrastructure that is needed to enable all of these social dimensions to work effectively. Without doubt, the role of government is crucial to utilise the resources available, identify national priorities and set innovative economic programmes that have resilient approaches in order to transform the economic and social condition of the country. This approach implicitly assumes the full engagement of the actors and institutions for cluster development, but generally the social conditions to enable high trust, social-context, human interactions are lacking in the design of green-field situations. A better approach for creating a new cluster, i.e. one that has a greater probability of reaching the sustainment phase of the cluster lifecycle model, is to plan the location in a mature social space that offers an attraction to knowledge workers to live and socialize. Attempts to build on cheap, green-field and (usually) remote locations will result in a counterproductive social environment.

8.8 SOCIAL DIMENSIONS IN CLUSTER

In cluster development, Saxenian (1985) admitted that social interaction among Stanford University's scientist and local entrepreneurs spark the spin-off and local technology champions that created the success of Silicon Valley. However, there is chaos on the provision of local social infrastructure such as the shortages of residential properties, transportation networks and the environment in the 70s when the production from the microelectronics industry was at its highest; before the big manufacturers relocated to other cheaper areas. Later, they left the North Silicon Valley as the high research and control centre, while the South and West became the growing microelectronic manufacturing centre. This showed that the social dimension influences organic cluster developments and it also matters for the engineered MSC cluster as previously discussed. This reinforces the importance of social capital as a contributing factor in cluster development and the theory has huge implications for economic development (Putnam, 1993) including forming innovation policies. Knowledge sharing through social networks within the cluster communities may be an essential topic to further understand how the regional innovation processes work (Storper, 1995); and thus stimulate the knowledge creation and dissemination beyond the spheres boundaries.

There are three major dimensions in social capital studies (Nahapiet and Ghoshal, 1998). Firstly, the structural dimension which is a pattern of connectivity between people such as the density of network, the uniqueness and bond strength to other actors. In this research, the survey data found that technology firms have less connection value with university and research institution as compare to other actors in the MSC (Table 6.10, Section 6.5.1.6). Secondly, the relational dimension, which incorporates the relationship of the actors including the personal relationship built with the contacts over the years; this is important for trust building between actors and its contacts.

In the MSC context, trust is important and it is vital to build as early as possible and to gain over the years based on work experiences i.e. collaborative projects. Informal meetings also provide the first steps to know the fellow actors or communities in the MSC, and when formal project are to begin, the risk of trust was embedded in the contractual agreement as a process of formality. Thirdly, the least measurement of social dimension by Nahapiet and Ghoshal (1998) is the cognitive dimension; referring to the norms, shared language and interpretation. For this research, the actors share similar culture and the English language (more commonly used other than Malay). There is another social dimension which is not put forward widely in cluster studies, the social infrastructure. This research found that the limitation of social infrastructure such as housing and transportation networks influence the social linkages among actors. The actors ended meetings at Kuala Lumpur since all the facilities were already established compare to Cyberjaya.

The summary of social dimension in the MSC is illustrated in Table 8.2 and this information is useful for the policy maker to understand the social condition of the actors involves in the MSC. This can provide a measure to analyse the appropriate strategy to improve the weakness of linkages among actors in cluster, and in particular, the social interaction between university and industry.

Social Dimension	Feature	MSC's Social Dimension Condition
Structural	Pattern of connectivity, density or size of networks, strength of tie between actors	University and research institution both have low density of connection, government, suppliers, foreign and local firms, financial institutions are all have strong value of connection. Intermediaries have medium value of connection.
Relational	Interconnection of relationship build over the years, previous experiences	Trust building start by informal meeting, risk of trust embedded in mutual agreement such as contract or MoU, previous experience counted for smooth business and social networking.
Cognitive	Similar norms, shared language and interpretation	Shared similar norms and languages.
Social infrastructure	Housing, school, convention centre, sport and recreational centre, health centre, transportation networks	Limited housing and residential area, limited bus services and workers commute with own or share car with colleague. Limited social and recreational centre in Cyberjaya resulting the population at night drop to 10000 compare during the day which is 50000 people .Access and choices to motorway are easy but charges apply. Commuters facing risk of road traffic during peak office hours linking Kuala Lumpur to main city of Cyberjaya. Transportation networks focus on Kuala Lumpur city centre.

Table 8.2: Social dimensions in the MSC cluster (Source: author)

8.9 CONCLUSION

This chapter has discussed and answered the research questions set for this research by triangulating the data gathered from survey questionnaire and interview with the targeted sample. The discussion is not limited to focus on the research questions but also addressed the implications of the data findings to other related subject including the conceptual model and cluster lifecycle. This includes the lesson that can be learnt to other policy makers if wishing to engineer their own cluster and also the important of social dimension in cluster development.

This research has explored, investigated and analysed the local operation system in the local innovation system by using MSC Malaysia as the case context in cluster studies. The research has uncovered the possibilities of creating or developing technology cluster for the purpose of economic, social, technology and knowledge transformation for less developed and/or developing countries; and/or any interested regional or sectorial policy makers for strategic local policies framework. The main challenge faced by MSC is the issues of opportunity for knowledge acquisition and absorptive capacity for the organisations (firms and institutions) to acquire, utilise, transform and exploit the knowledge. In the case of MSC, it was found that the social infrastructure is matters for the actors to interact and connect with their communities. The lack of social infrastructure and low strength of collaboration tie and value result in disappointing impact to the effectiveness of social linkages activities between university and industry in particular. Thus this has influenced the effectiveness of interaction and linkages among system actors and the dynamic of the cluster. More comprehensive and robust measures are certainly needed for MSC to further excel and this research can be used to begin with. A mature social space that offers attractions to knowledge workers to live and socialise would probably be a better approach for developing a new cluster.

The outcome from this research and discussion provides new input on both theories used i.e. Porter's Diamond model and Triple Helix, thus contributes to the knowledge on the theoretical implications. The conceptual model has been tested in the case context with the cluster life-cycle model and the result (Table 8.1) contributes to the practical implications.

CHAPTER 9

CONCLUSION

9.1 INTRODUCTION

This chapter presents the critical reflections from the research findings and discussion, and concludes by: (1) summarising the research findings; (2) discussing the contributions to the theoretical and practical knowledge; and (3) presenting the limitations of the research. Finally, the future proposals to extend the research are presented.

This research has examined and measured the state of engineered industrial cluster (MSC in Malaysia as context of case studies) including its components in the local innovation system (i.e. system actors - firms, institutions, government; local operation factors, policies and interaction – collaboration and linkages). The innovation literature includes the innovation system and cluster development was used as part of the main concept used for theoretical understanding of this research. Models of cluster development (i.e. NIS, Porter's Diamond model and triple helix) were used to develop the conceptual framework (model). Mixed methods were used to collect and analyse the collected data. The cluster development were analysed and used the system impact metrics built based on the conceptual model and cluster lifecycle. The research outcomes have revealed that cluster development for technology, innovation and economic transformation were depend on the availability and capability of each key factors (determinants) and its dynamic in the cluster. The provision of mature social space was found lacking in research context and influenced the opportunity for the effectiveness of knowledge transfer process and absorptive capacity.

Overall, the triangulation approach was used in three key part of the research, (1) data triangulation between quantitative (numbers analyses with descriptive data and Mann-Whitney U test) and qualitative data (narrative analyses with thematic analysis, coding and influence diagram); (2) method triangulation between on-line survey (quantitative) and face-to-face interview (qualitative); and (3) theory/concept triangulation between NIS, Porter's Diamond model, triple helix, collaborative innovation and business networking. The approach contributed in corroborating and validating the data collected, methods and theories/concepts used. The contributions of this research were identified in the way the research were conducted (research process), the theoretical implications in literature and concepts/models used and finally the practical implication in the context of Malaysia and developing countries. There were opportunities discovered to expand this research in future on strategic impact of collaborative relationship among triple helix actors and the impact of soft determinants for social networking in cluster development.

9.2 SUMMARY OF RESEARCH FINDINGS AND THESIS

The industrial and economic policy in Malaysia over the years has focused on technology clusters as key drivers for growth. This thesis highlighted the need to further understand the effectiveness and role of actors, collaboration and social interaction in supporting the development of the cluster while increasing competitiveness and innovation in the context of developing countries; such as Malaysia. The associated literature on the subject areas were presented in Chapter Two and Three followed by

Chapter Four where the contextual perspective of this research was presented and discussed. The concept of cluster and triple helix collaboration has been used to guide this investigation. A conceptual framework was designed to better understand the context of the research studies and this was presented in Chapter Three. Both quantitative and qualitative data collection techniques were used for the investigation of this research. They were developed using the survey and interview techniques whereupon the respondents were carefully selected to meet the desired characteristic of the research studies. Further explanation of the research methodology was presented in Chapter Five. The research findings were presented and analysed in two separate chapters which are in Chapter Six for the quantitative data gathered through survey investigation and Chapter Seven for the qualitative data gathered through interview investigation. The main findings of the research will be summarised and presented in the following subsections.

9.2.1 The State of the MSC Cluster

The state of technology firms (ICT and Biotechnology) in the MSC are progressing at a pace determined by the state of the identified determinants. A majority of the firms in the MSC developed their business formation ideas from the strategic collaboration of firms either with other individual companies or institutions to achieve their objectives; which would not be possible on their own. Among other important determinants, government policy and regulation are the most influential elements to support firm formation and development of firms within the MSC.

The policies of the Malaysian government, such as the provision of recognition status for firm (MSC Status and BioNexus Status); and the Research University Status were also recognised as being important in supporting the development of the cluster at least within the context of Malaysia's MSC. The least influential or supporting determinants in cluster building are the physical location of firms and limited support from the universities. The anticipated cluster location premium was found to be of little significance to technology firms in the MSC, particularly to those from the ICT industry. This may be attributed to the notion of a borderless world and the advancement of telecommunication platforms. The latter has made it more affordable and convenient to conduct business through the use of modern technology such as the internet and teleconferencing. However, Biotechnology firms do believe and rely on the importance of proximity in order for them to progress their research and development (R&D) activities. Or, more likely, based on the findings of this work, this trend may be as a consequence of few social interaction opportunities in the MSC cluster geography. The value of proximity and the key consequential knowledge spill-overs that characterize a sustaining cluster are not realized.

9.2.2 The Triple Helix Perspective: The Role of Actors within the Cluster

This research found significant effects of the cluster's determinants on the role of collaboration for firm development. Both primary data sources (Section 6.5.2.1 and 7.5.1) found the motives of collaboration within a cluster are for business and competitiveness reasons. However, it was also found that there are elements that limit the success of collaborative relationships for firm development; these include the state and conditions of the determinants in the cluster such as; (1) limited technical expertise and scientists; (2) lack of university-industry linkages; (3) bureaucracy; (4) difficulty in connecting to market; (5) lack of marketable research; and finally (6) financial stress or limitation. Overall it can be concluded from this that improving the social infrastructure, education system and effective role of intermediaries are possible strategic enhancements that can strengthen collaborative relationships to support the success cluster development.

This examination from the perspective of triple helix actors in MSC found that among the three, the role of government was found to be most dominant in providing a conducive economic environment for the cluster as well as providing the connective tactics between university and industry. The main challenge for the Malaysia government is its responsibility to attract and develop local technology capacity for local economies while nurturing local champions in this technology cluster. At this phase of the cluster development, less emphasis on FDI is necessary, and a greater concentration of future investments and collaborative forming activities with actors in the clusters to help create unique transforming technologies.

The research also identified important roles in creating a successful cluster including that of labour pooling of local and foreign skills, agent to university and government and social support to motivate local firm to be more competitive. However, local technology firms are still reliant on outside technology that is cheaper and more reliable. This has influenced and affected the development of indigenous technology production. With regards to the universities, it was found that their responsibilities to local knowledge transfer are increasing as they take on further roles in helping industry while maintaining the its traditional role in teaching and research (Table 7.3, Section 7.4). Although universities have been given autonomy for organising, structuring and managing their institutions, they remain influenced by the Ministry of Higher Education (government), and their emphasis on the traditional university outputs. As a result of this technology firms found that universities have a low level ability to leverage their collaborative relationship with the industry and their role is seen to be more inclined to generate and support skills in the cluster (graduates) rather than transforming the cluster itself by aligning their knowledge assets. The role of intermediaries was found to be a weak broker between the universities and local industry. The role of intermediaries is recognised as important (Section 7.4.4) and is the main instrument of government for supporting the MSC development.

9.2.3 Differentiating MSC with other Clusters

This research found there are three significant differences between the MSC and other (successful) clusters based on the key determinants of cluster development (Section 8.5). Firstly, government policy and regulations were found to have a dominant influence in the MSC since it was first launched in 1996. It has attracted foreign firms such as IBM, Shell and DELL to locate their operation in the MSC, thus providing jobs for locals that contribute towards the economic growth of the area. The political stability and continues Vision 2020 lead by three different Prime Ministers also contributes to the condition of the government policies and regulations that drives the continuous development of the MSC.

Secondly, the weak role played by universities is major differences compare with Silicon Valley or Cambridge (strong link between university, industry and government). In relation to Etzkowitz's Triple Helix relationship, the MSC can be positioned in the "transition stage" i.e. moving from "statist" to "lassie-faire stage".

Finally, the "green-field" location factor was found to be the main difference with other clusters. There is a lack of social infrastructure that can enhance the knowledge spill-over opportunity to happen. The lack of provision of a mature social context was found to be of critical importance for the development of the MSC.

9.3 CONTRIBUTIONS OF THE RESEARCH

The cluster concept has become one of the main focuses within regional studies and economic growth literature. This research further expanded the understanding of collaboration capability in cluster development through the perspective of developing countries such as Malaysia. This research also uncovered some indications on the limitation in the use of the triple helix model and Porter's concept of cluster development. Therefore the research offers enhancements of both theory and practice in the area of cluster concepts, triple helix model and regional studies.

9.3.1 Research Process

A specific research methodology was developed for this investigation. It is unique in the sense that it differs from other cluster studies by the type of research method employed: most cluster studies employ a quantitative data collection technique to help measure and examine the relationship between different variables using only statistical procedures. This limits the understanding of the in-depth meaning of the data collected which can only be achieved with the use of qualitative data collection techniques. In addressing this concern, this research adopted a mixture of method approach by combining a quantitative method (survey) and a qualitative method (interview). Also, by using a mixed methods approach the research design offers a self-validating, triangulation configuration. In other words, the research method employed made the results of the research more reliable for collaboration and cluster studies.

9.3.2 Theoretical implications

The establishment of conceptual model (Figure 3.11) for this study were develop through a series of modification with the used of several theories or models (Section

3.2) that were considered as pragmatic and useful to aids this research investigation. The conceptual model was then used and tested on its practicality in the context of the research study, and resulted in the assessment on key theories used. Thus, contribute toward the literature debate on the theoretical framework used for this study.

- **Porter's Diamond model**

The cluster concept embedded in Porter's Diamond model of competitiveness for innovation is a dynamic model that focuses on geographic concentration (location) of inter-linkages of firms with others, and how that location encourages the development and upgrading the social values and business performance. This means that the concept suggests business environment in the cluster is important to influence the competitiveness and economic impact of the location.

The model has little emphasis on how the firm's inter-linkages with other and neglected the important role of the provision of social dimension i.e. social-infrastructure as one of determinants that were considered important to enhance for cluster development. Furthermore, the model does not address how the cluster might be developed (engineer) and how to evaluate the state or phase of the cluster development.

The conceptual model of this research has contributed to expand the Porter's model by including the role of collaboration as strategic technique for firms to inter-linkages with other based on the capability of the collaborations i.e. motives and barriers, for the development of cluster. In order to measure the position of cluster development, this research has employs the cluster lifecycle concept (Section 2.3.2,) by giving impact condition (Table 2.1, Section 2.4) of each determinants according to different phase in the cluster lifecycle. Thus, the condition of the cluster can be identified and measured according to its phase i.e. emergence, growth, sustainability, decline or maturity, so that the policy adviser can plan the necessary adjustment in their policies and investment in order to improve the condition of the cluster.

The outcome of this research has discovered that the social dimension is also important in the macro factors of cluster environment which was lacking in Porter's model for competitiveness of cluster development. The case used for this research has experienced difficulties in its cluster development as there was lack of the social-infrastructure provision for the system actors to do the social inter-linkages that was considered important for the knowledge spill-over opportunity to happen (discussed in Section 8.6, 8.7 and 8.8). This phenomenon has limits the technology firms (in the case context) to socially meeting with others for either business or social activities purposes. This resulted for firms having to meeting at other location which the provision of the social place and services already in place. This was also related to the factor of close distance with the neighbouring city that has well-established social infrastructure which hindering the progress of the cluster development.

The element of geographic proximity (location) was found to less valuable than Porter's work suggests, as the finding of this research (Section 6.5.1.4) indicates that there is weak evidence to supporting Porter's theory on the geographic concentration at least in the context of engineered cluster in developing countries (in this case the Malaysia MSC). The interconnection and communication among firms during the time Porter developed his cluster concept might have influenced his view as at the time communication is largely based on face-to-face meeting due to a number of reasons. The reason behind this can attributed to: (1) the infancy stage of ICT; (2) limited resources; and (3) high cost of implementing cutting edge communication technology. Compared to today, the advancement and use of communication technology is varied and location it can be said that we now live in a borderless world where it is easier to communicate with one another using telecommunication technology. Firms can communicate not only within its regional and cluster proximity but also beyond national and regional boundaries. Thus, it is faster, efficient and more affordable for all including early start-ups to conduct business. The survey and interview findings in this research suggest that the physical location of the firms does not matter in the development of their business as the location becomes virtual due to advances in telecommunication and internet.

Overall the structure of Porter's diamond model can still be considered relevant to the reality of cluster formation. However, the results of this research indicates that an adapter version would be more complete if the dimensions of "Factor Conditions" and "Related and Supporting Industries" are extended to accommodate the social determinants that are critical to form the social infrastructure for cluster development in situations where they are engineered spatially separate from any established towns or cities.

- **Triple Helix Model**

The adoption of Triple Helix model (Section 3.2.3) in this research has found that the model was too general, with only three cores stages of institutional transformation in relation to the role played by each of its core actors i.e. university, industry (firms) and government in the helix. The model fails to explain the role played by actors in the transition between each of three stages i.e. transition from "statist" to "laissez faire", transition from "laissez faire" to "hybrid" and any form of transition after the "hybrid" stage. This limitation was found with the case study in this research. The state of the "helix" was in transition from statist to laissez-faire (Figure 8.5, Section 8.4.3). By using the conceptual model methodology and considering a lifecycle development framework, it is instructive to consider the identification of other "helix states" that offer a greater understanding and resolution of Triple Helix evolution stages. In each of the cluster lifecycle phase, the role of actors has a different level of impact i.e. dominant role in the cluster development. Consequently provides opportunity for future research on the application of Triple Helix model.

- **National System of Innovation (NIS)**

The weaknesses of NIS discussed in Section 3.2.1 have highlighted the insufficiency of empirical system mapping (Godin, 2009) and narrow focus on the role of government for concept and policies practices. This study has proposed a conceptual model that is dynamic not only with the inclusion of the critical roles played by actors (university, industry and government) but also provides a strategic mechanism to measure the key determinants (Section 2.3.3) other than the policies that associated with the successful cluster development – growth and GDP contribution. The use of the conceptual model and output impact measures of the cluster lifecycle provides guidelines and benchmarks for policy makers in strategic planning of their future projects and investments. Therefore, this research has contributed knowledge in terms of the application of conceptual models of determinants in reducing the weaknesses of NIS approaches.

9.3.3 Practical Implications for Evaluating Cluster Collaboration Relationships

This research furthers the knowledge on the policies and practicalities of emphasising an industrial cluster as a strategic initiative to transform developing countries such as Malaysia. The work is among the first to investigate the use of collaboration in both cluster and triple helix concepts for the development of engineered cluster in general from the perspective of developing countries. The research findings suggest that the necessary conditions for triple helix collaboration are dependent on a series of determinant states established in the conceptual model of cluster collaboration. This model can be used as a new framework for analysing the collaboration potential in clusters, and develop an insight to the relative contribution of the system actors. This framework suggest that collaboration cannot be done successfully if the determinants were not ready and the cluster determinants cannot be run smoothly if there is no active collaboration among university-industry-government along with the active role of actors in the cluster.

9.4 LIMITATION OF RESEARCH

- ***Sample size***

This research is subjected to number of challenges that restricted the effectiveness of selected research techniques used and therefore on reliability of the research findings. Firstly, the sample size of survey was not large (88 technology firms) and this could have influenced the result of the survey. The size of sample was however restricted by the characteristics and background of the targeted pool of respondents in this research i.e. nature of business (ICT and Biotech industry), designation of respondents (officer and above), location (within MSC area) and experience in collaboration with university, industry and government. Another reason for the limited number of respondents in the survey can be attributed to the quality of the company database maintained by local agencies. However, the interview findings (21 interview respondents) are used to validate the survey finding with in-depth explanation and meaning of the data collected.

A second limitation of this research was due to time and cost which constrained the quantity of face-to-face interviews. The interview was conducted during the fasting month (Ramadan month) in Malaysia and during this period, the operating business and working hours shorten between two to three hours depending on the organisation, thus offices normally close at 3pm. This gives time to Muslim employees to go home and prepare for their *iftar* (breaking the fast) at 7pm. Thus there were limited time schedule to conduct the interview session. In this research, the interviewee from university is concentrating on teaching, administrative works and students consultation thus difficult to schedule the interview. Indeed, this limitation of research testified to the findings and teaching responsibility that impedes university in having active collaborative research and relationship with the industry. Throughout the period of data collection, the meeting with interviewees has to be re-scheduled and changed different location of meeting with resulted in the increase cost of conducting the research i.e. travelling. Nonetheless, the selected interview sample was carefully selected and interviewed to meet the purpose of this research. The used of purposive sampling approach, key individuals (actors) that have deep understanding of knowledge and experience in university-industry-government relationship in MSC were selected.

- ***Coding Process***

The long narrative text and the use of a coding process during the analysing of the interview data can lead to subjective choices for the researcher to code, interpret and analysed the data; and can thus influence and bias data collected (Akerlind, 2012; Weston et al, 2001; Webb, 1997) . The use of a computer assisted content analysis software package; QSR NVivo 10 has helped the researcher to minimize this limitation and managed the data more easily to enhance the reliability and quality of the findings and subsequently the outcome of this thesis.

9.5 PLANNING FOR FUTURE RESEARCH

A recommendation for future research is to extend the number of survey respondents and interviewees to better represent the population. The findings have revealed the role of government and its innovative policies as major contributing factors in the development of the MSC engineered cluster, and support to enhance the collaboration capability in the cluster. This is evident in the survey and interview findings as well as the involvement of university and industry in some collaborative projects undertaken. However the role of government on its policy has not created the expected production of indigenous technology products and services, or promotion of technology firms in the global market.

Future research would benefit by looking at the strategic impact of collaborative relationships among triple helix actors including university, industry and government in producing indigenous technology. A multiple case study approach would be advised to address this complex issue.

The finding and discussion of this research highlighted the practical implications of the location factor in cluster studies. From this, it is recommended that further studies can be undertaken on the impact of the soft determinants for social networking.

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APPENDIX 1

MSC MALAYSIA BILL OF GUARANTEES

Introduction

The grant of MSC Malaysia Status entitles qualified entities1 to a set of incentives, rights and privileges from the Government of Malaysia (**Government**), namely the MSC Malaysia Bill of Guarantees (**BoGs**). The BoGs reflects the Government's intention to provide an environment in MSC Malaysia that is conducive to the development of MSC Malaysia Status entities. The Incentives, rights and privileges granted pursuant to the BOGs are subject to requirements under relevant laws and regulations. In addition, entitlement to the BoGs are conditional upon compliance of MSC Malaysia Status entities, with such terms and conditions as may be imposed by the Government and/or the Multimedia Development Corporation (MDeC), as the organisation mandated by the Government to coordinate, promote and develop the Information and Communications Technology (ICT) industry and selected services in MSC Malaysia and Malaysia.

While the Government will reasonably exercise all authority and power towards providing the relevant incentives, rights and privileges under the BoGs, the actual provision will be dependent upon a range of factors and parties (both public and private), and can be affected by circumstances that are not within the control of the Government.

The BoGs are as follows:

- BoG 1: To provide a world-class physical and information infrastructure.
- BoG 2: To allow unrestricted employment of local and foreign knowledge workers.
- BoG 3: To ensure freedom of ownership by exempting companies with MSC Malaysia Status from local ownership requirements.
- BoG 4: To give the freedom to source capital globally for MSC Malaysia infrastructure, and the right to borrow funds globally.
- BoG 5: To provide competitive financial incentives, including Pioneer Status (100 percent tax exemption) for up to ten years or an Investment Tax Allowance for up to five years and no duties on the importation of multimedia equipment.
- BoG 6: To become a regional leader in Intellectual Property Protection and Cyberlaws.
- BoG 7: To ensure no censorship of the Internet.
- BoG 8: To provide globally competitive telecommunications tariffs.
- BoG 9: To tender key MSC Malaysia infrastructure contracts to leading companies willing to use MSC Malaysia as their regional hub.
- BoG 10: To provide a high-powered implementation agency to act as an effective one-stop super shop.

This document reflects the Government's interpretation in respect of the BoGs, and may be subject to change. For further information, please contact MDeC at:

MSC Malaysia

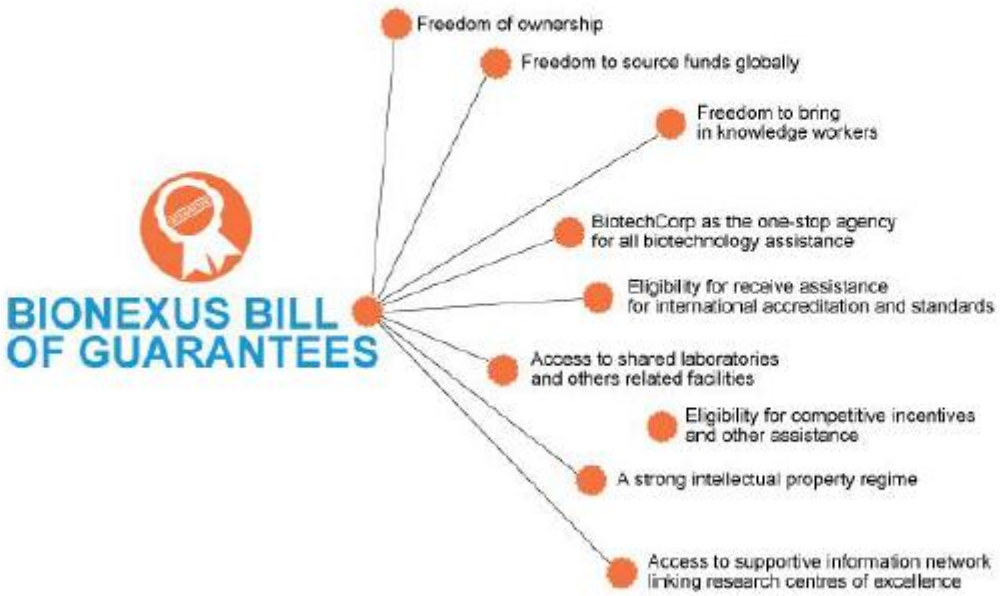
Client Contact Centre (CliC)

Tel.no.:+603-83153000
Toll free no.: 1-800-88-8338 (within Malaysia)

APPENDIX 2

BIONEXUS BILL OF GUARANTEES

Every BioNexus company is guaranteed the below list of privileges devised to foster an environment for research and business development:



Eligibility Criteria for BioNexus Status

We would like to draw your kind attention to the changes in the eligibility criteria for BioNexus Status application which will take effect on 1 February 2012.

The change in the eligibility criteria is necessary to enhance the quality of the BioNexus framework and meet the changing requirements of the market.

You are required to fully understand the eligibility criteria before proceeding with your application and for comprehensive guidance on the application process for BioNexus Status, you can refer to the following Guidance Papers:

- Guidelines On The Process & Procedures For BioNexus Status Application
- Guideline on BioNexus Qualifying Criteria

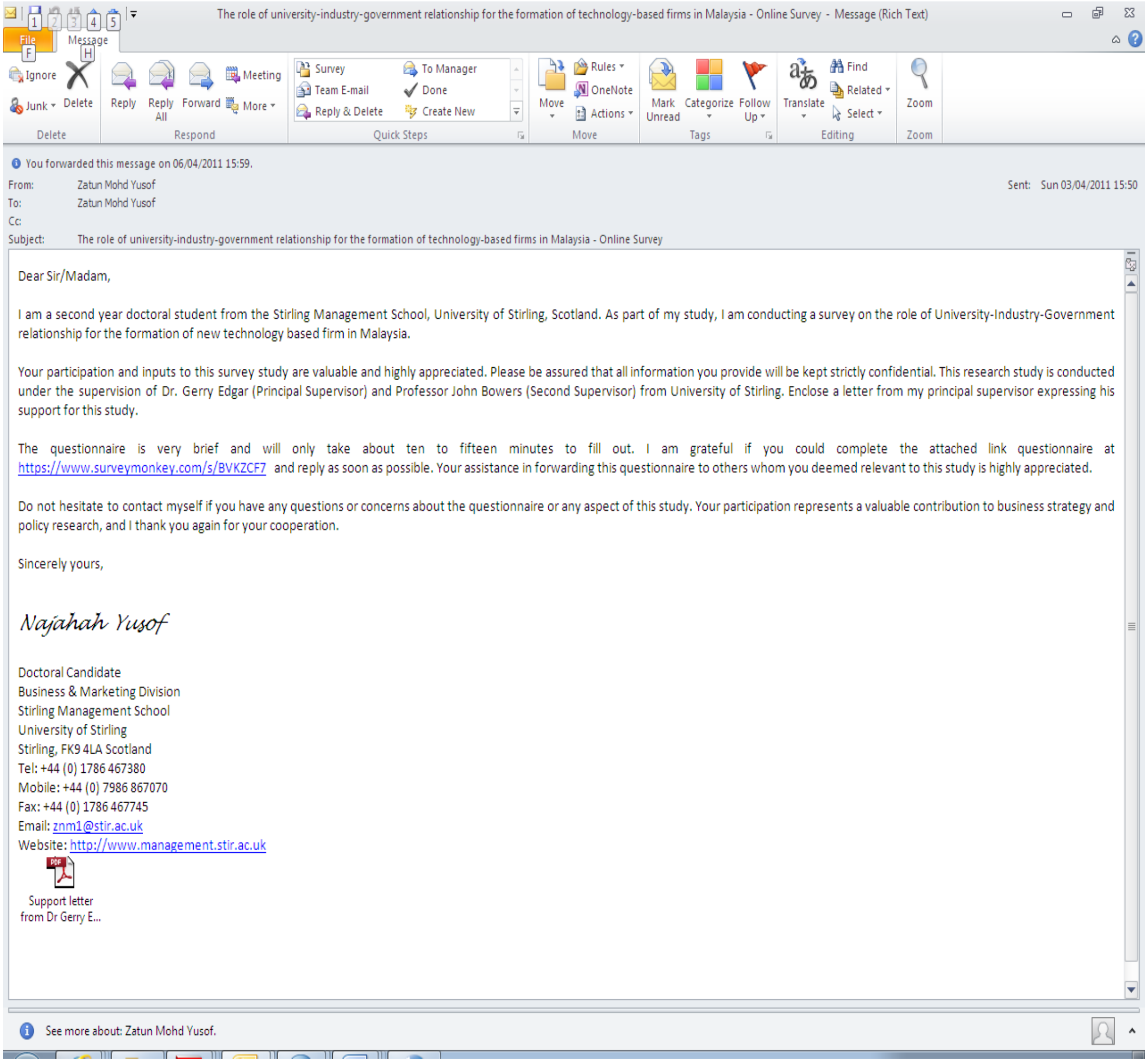
BioNexus Tax Incentives

A company undertaking biotechnology activity and has been approved with BioNexus Status by the Malaysian Biotechnology Corporation Sdn. Bhd. (BiotechCorp) may apply for the following incentives:

1. An exemption from tax on 100% statutory income :
    - For a period of ten (10) consecutive years of assessment from the first year the company derived statutory income from the new business; or
    - For a period of five (5) consecutive years of assessment from the first year the company derived statutory income from the existing business and expansion project; or
2. An exemption of 100% statutory income derived from a new business or an expansion project that is equivalent to an allowance of 100% of qualifying capital expenditure incurred for a period of five (5) years.
3. A BioNexus Status company is entitled to a concessionary tax rate of 20% on statutory income from qualifying activities for ten (10) years upon the expiry of the tax exemption period.
4. Tax exemption on dividends distributed by a BioNexus Status company.
5. Exemption of import duty and sales tax on imported raw materials/components and machinery and equipment.
6. Double deduction on expenditure incurred for R&D.
7. Double deduction on expenditure incurred for the promotion of exports.
8. With effect from 2 September 2006, qualifying buildings used solely for the purpose of biotechnology activities will be eligible for Industrial Building Allowance to be claimed over a period of 10 years.
9. A company or an individual (that carry on business) investing in a BioNexus Status company is eligible for a tax deduction equivalent to the total investment made in seed capital or early stage financing.

APPENDIX 3

ONLINE SURVEY QUESTIONNAIRE



The role of university-industry-government relationship for the formation of technology-based firms in Malaysia - Online Survey - Message (Rich Text)

You forwarded this message on 06/04/2011 15:59.

From: Zatun Mohd Yusof

To: Zatun Mohd Yusof

Cc:

Subject: The role of university-industry-government relationship for the formation of technology-based firms in Malaysia - Online Survey

Sent: Sun 03/04/2011 15:50

Dear Sir/Madam,

I am a second year doctoral student from the Stirling Management School, University of Stirling, Scotland. As part of my study, I am conducting a survey on the role of University-Industry-Government relationship for the formation of new technology based firm in Malaysia.

Your participation and inputs to this survey study are valuable and highly appreciated. Please be assured that all information you provide will be kept strictly confidential. This research study is conducted under the supervision of Dr. Gerry Edgar (Principal Supervisor) and Professor John Bowers (Second Supervisor) from University of Stirling. Enclose a letter from my principal supervisor expressing his support for this study.

The questionnaire is very brief and will only take about ten to fifteen minutes to fill out. I am grateful if you could complete the attached link questionnaire at https://www.surveymonkey.com/s/BVKZCF7 and reply as soon as possible. Your assistance in forwarding this questionnaire to others whom you deemed relevant to this study is highly appreciated.

Do not hesitate to contact myself if you have any questions or concerns about the questionnaire or any aspect of this study. Your participation represents a valuable contribution to business strategy and policy research, and I thank you again for your cooperation.

Sincerely yours,

Najahah Yusof

Doctoral Candidate
Business & Marketing Division
Stirling Management School
University of Stirling
Stirling, FK9 4LA Scotland
Tel: +44 (0) 1786 467380
Mobile: +44 (0) 7986 867070
Fax: +44 (0) 1786 467745
Email: znm1@stir.ac.uk
Website: http://www.management.stir.ac.uk

Support letter from Dr Gerry E...

See more about: Zatun Mohd Yusof.

UNIVERSITY OF STIRLING

Dr. Gerry Edgar
Business & Marketing Division
Stirling Management School
University of Stirling
Stirling, FK9 4LA Scotland
Tel: +44 (0) 1786 467371
Fax: +44 (0) 1786 467745
Email: gerry.edgar@stir.ac.uk
Website: http://www.management.stir.ac.uk

1st March 2011

Dear Sir/Madam,

I am Dr Gerry Edgar, Principal Supervisor to Zatun Najahah Mohd Yusof (also known as Naja), second year doctoral student from the Stirling Management School, University of Stirling, Scotland. Naja is currently conducting a survey on the role of University-Industry-Government relationship for the formation of new technology based firm in of Malaysia.

The ability to conduct original investigation and assess ideas critically is a core part of the doctoral requirement. Thus your participation and commitments to this survey are valuable for Naja's studies. I can assure you that all information you provide will be kept strictly confidential. The questionnaire is very brief and will only take about ten minutes to complete.

Please do not hesitate to contact myself if you have any questions or concerns about her study. Your participation and cooperation is greatly appreciated.

Thank you.

Yours sincerely,

Gerry Edgar

Lecturer
University of Stirling

UNIVERSITY OF STIRLING

THE ROLE OF UNIVERSITY-INDUSTRY-GOVERNMENT RELATIONSHIP FOR THE FORMATION OF NEW TECHNOLOGY BASED FIRMS IN MALAYSIA

Section 1: Demographic Profile

1.1 What is your current position?

□ Officer □ Researcher □ Manager □ Senior Management

□ Owner

1.2 Indicate the primary industry category of your organisation best fits.

□ Information & Communication Technology
- □ Creative Multimedia
- □ Software Development
- □ Support Services
- □ Hardware Design
- □ Internet Based Business
- □ Shared Services & Outsourcing

□ Biotechnology
- □ Agriculture
- □ Healthcare
- □ Industrial

□ Electric & Electronic

□ Other:__________________________________(please specify)

1.3 Indicate the location of your organisation.

- □ Cyberjaya
- □ Technology Park Malaysia
- □ UPM-MTDC
- □ Kuala Lumpur City Centre (KLCC)
- □ Kuala Lumpur Tower
- □ KL Sentral
- □ TM Cybercentre Complex
- □ Mid Valley City
- □ i-City
- □ Bandar Utama
- □ Bangsar South City
- □ G Tower
- □ Symphony House
- □ Quill 9 (Petaling Jaya)
- □ Others:_______________ *(Please Specify)*

1.4 What is the ownership status of your organisation?

Organisation	**Status of Ownership**		
	Private	**Public**	**Public & Private**
Local	□	□	□
Foreign	□	□	□
Local & Foreign	□	□	□

1.5 How many employees are in your organisation?

□ 1 – 10 employees □ 11 – 50 employees □ 51 – 250 employees

□ More than 250 employees

1.6 How was the original business idea of this organisation developed?

□ Independently

□ In another company

□ In another institution (e.g. university)

□ Collaboration with another company

□ Collaboration with another institution

□ Other :_______________________________*(Please specify)*

1.7 How long has your organisation been in existence: _______________ year(s)

1.8 Has your organisation received any of the following status recognitions?

□ Multimedia Super Corridor Status □ Bionexus Partner Status

□ Other: ____________ *(please specify)* □ None *(proceed to 1.11)*

1.9 How would you rate the impact of having the status recognition to your organisation on a scale 1 *(No Impact)* to 5 *(Very High Impact).*

□ 1 = No Impact □ 2 = Less Impact □ 3 = Medium Impact

□ 4 = High Impact □ 5 = Very High Impact

1.10 How would you rate the impact of research & development activities to your organisation on a scale 1 *(No Impact)* to 5 *(Very High Impact).*

□ 1 = No Impact □ 2 = Less Impact □ 3 = Medium Impact

□ 4 = High Impact □ 5 = Very High Impact

Section 2: Factors contributing to support firm formation

2.1 Based on your current location and experience, rate the importance of the following factors to your organisation?

1	2	3	4	5
Not Important	*Less Important*	*Medium Important*	*Important*	*Very Important*

Factors	Not Important 1	Less Important 2	Medium Important 3	Important 4	Very Importan 5
Close relationship and/or active social interaction with university.	□	□	□	□	□
Close relationship and/or active social interaction with industry e.g. other firms, research & financial institution.	□	□	□	□	□
Close relationship and/or active social interaction with government's agencies.	□	□	□	□	□
Availability and quality of local entrepreneurs and skills.	□	□	□	□	□
Technology availability	□	□	□	□	□
Availability and quality of local education and training.	□	□	□	□	□
Availability and accessibility of local financial support.	□	□	□	□	□
Physical location of premises.	□	□	□	□	□
Involvement and allocation of investment in R&D activities.	□	□	□	□	□
Connection to market (e.g. commercialisation process know-how, role of intermediaries).	□	□	□	□	□
The support issues of intellectual property right and patent.	□	□	□	□	□
The role of government in its support, policy and regulations.	□	□	□	□	□
The behaviour, norms and practices of local culture including trust issues.	□	□	□	□	□
Other:________________________*(please specify)*	□	□	□	□	□

2.2 What is your opinion on the following local factors for your business performance?

1	2	3	4	5
Not Satisfied	*Less Satisfied*	*Medium Satisfied*	*Satisfied*	*Very Satisfied*

Local's condition	**Not Satisfied** 1	2	3	4	**Very Satisfied** 5
Quantity of local skills in your industry	□	□	□	□	□
Quality of local skills in your industry	□	□	□	□	□
Cost to employ locals in your industry	□	□	□	□	□
Work ethic of related people in your industry	□	□	□	□	□
Organisation's current geographic location in your industry	□	□	□	□	□
Role of local university to facilitate knowledge transfer activities	□	□	□	□	□
Role of local research institution to facilitate knowledge transfer activities	□	□	□	□	□
Availability to access finance for your industry	□	□	□	□	□
Availability of venture capital to invest in your industry	□	□	□	□	□
Communication system e.g. internet connection	□	□	□	□	□
Mail and parcel delivery	□	□	□	□	□
Road and transport system e.g. train, bus and etc.	□	□	□	□	□
Health care services	□	□	□	□	□
Housing availability and services	□	□	□	□	□
Availability of local amenities	□	□	□	□	□

2.3 Indicate the majority customers of your organisation's products and/or services.

□ Local markets □ Overseas markets □ Both (local & overseas markets)

2.4 Rate the local support condition in assisting business start-up in your industry from scale 1 (very difficult) to 5 (very easy).

□ 1 = Very Difficult □ 2 = Difficult □ 3 = Medium

□ 4 = Easy □ 5 = Very Easy

2.5 Indicate the majority suppliers of your organisation's products and/or services.

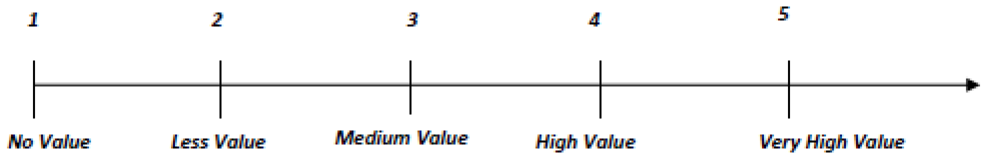
□ Local suppliers □ Overseas suppliers □ Both (local & overseas suppliers)

2.6 Indicate the condition to reach your supplier for your business from scale 1 (Very Difficult) to 5 (Very Easy).

□ 1 = Very Difficult □ 2 = Difficult □ 3 = Medium

□ 4 = Easy □ 5 = Very Easy

2.7 Rate the following partners on the value of their collaboration to your organisation?



Collaborators	No Value 1	2	3	4	Very High Value 5
Local entrepreneurs	□	□	□	□	□
Local firms	□	□	□	□	□
Foreign or other firms	□	□	□	□	□
Suppliers	□	□	□	□	□
Customers	□	□	□	□	□
Financial institutions (e.g. local bank, venture capital and/or investors)	□	□	□	□	□
Academia (e.g. university, college)	□	□	□	□	□
Research institutions (e.g. incubator, science park)	□	□	□	□	□
Intermediaries (e.g. trade association, MIDA, Biotech Corp, Multimedia Dev. Corp., etc)	□	□	□	□	□
Government (e.g. Ministry or Agencies)	□	□	□	□	□

Section 3: Relationship and Social Interaction of University-Industry-Government (U-I-G)

3.1 What objectives did you expect from collaboration and/or other knowledge seeking activities over the last 5 years and its impact to your organisation?

1	2	3	4	5
No Impact	*Less Impact*	*Medium Impact*	*High Impact*	*Very High Impact*

Objectives of Collaboration	**No Impact**			**Very High Impact**	
	1	**2**	**3**	**4**	**5**
To increase numbers of research papers publication	□	□	□	□	□
To achieve self-recognition and be known by others	□	□	□	□	□
To develop new ideas (e.g. technology, design of product or process)	□	□	□	□	□
To increase the possibility of formatting new business venture (e.g. open your own company / start-up)	□	□	□	□	□
To upgrade and increase the quality of R&D	□	□	□	□	□
To increase business opportunity (e.g. connection to market)	□	□	□	□	□
To achieve profit maximisation	□	□	□	□	□
Strengthen the position of your organisation in a competitive cluster of your business industry	□	□	□	□	□
Improves and gain technical skills & know-how of selected technologies	□	□	□	□	□
Ability to use collaborators patent e.g. licensing of patent	□	□	□	□	□
Enjoy the tax benefit/credit from government (e.g. government support programme to encourage collaboration)	□	□	□	□	□
Increase social networking contact and reputation	□	□	□	□	□
Access of funding e.g. Grant Scheme provides by government	□	□	□	□	□
Ability to use sophisticated and expensive technologies or equipment that your organisation do not have	□	□	□	□	□
Ability to reach and choose the best and talented students to work with your organisation	□	□	□	□	□
Government influence and policy that you have to collaborate with others (e.g. sometimes government has sign the memorandum of understanding (MoU) with other international firm to improve political relationship)	□	□	□	□	□
To increase social commitment and trust benefit with your collaborators	□	□	□	□	□
Other:____________________ *(please specify)*	□	□	□	□	□

3.2 What were/are the problems you have experiencing in collaborating and/or other seeking knowledge activities and its impact to your organisation based on the following statement?

1	2	3	4	5
No Impact	*Less Impact*	*Medium Impact*	*High Impact*	*Very High Impact*

Barriers/Problem Experienced	**No Impact 1**	**2**	**3**	**4**	**Very High Impact 5**
Time consuming to achieve mutual agreement between collaborators	☐	☐	☐	☐	☐
Bureaucratic and too many authorisation causes longer time to start collaboration work	☐	☐	☐	☐	☐
Longer process of financing start from submit application to receiving the funds	☐	☐	☐	☐	☐
Different interest of venture capitalist /investor	☐	☐	☐	☐	☐
Inexperience and difficulty in connecting to market (e.g. marketing and commercialisation activities)	☐	☐	☐	☐	☐
Unclear policy and guidelines of using patent	☐	☐	☐	☐	☐
Lack of R&D equipment and expertise	☐	☐	☐	☐	☐
Priority of collaboration is just to get self-recognition and sense of achievement	☐	☐	☐	☐	☐
The influence of external/foreign organisations or large organisation in business environment.	☐	☐	☐	☐	☐
Different interest and objectives of collaborators	☐	☐	☐	☐	☐
Geographic location of collaborators	☐	☐	☐	☐	☐
Limitation of local skills contribution in collaboration	☐	☐	☐	☐	☐
Limitation of local technology contribution in collaboration	☐	☐	☐	☐	☐
Lack of understanding in norms, values, practices and environment of collaborators	☐	☐	☐	☐	☐
Inability to share the information with others except with close friends / contacts	☐	☐	☐	☐	☐
Too much secrecy and curiosity in sharing information	☐	☐	☐	☐	☐
Gift-giving or reward practices (favour to the other parties when sharing or passing new method or process or formula)	☐	☐	☐	☐	☐
Others:______________________ *(please specify)*	☐	☐	☐	☐	☐

3.3 What would enhance the effectiveness of collaborating and/or other knowledge seeking activities?

1	2	3	4	5
No Impact	*Less Impact*	*Medium Impact*	*High Impact*	*Very High Impact*

Potential outcomes to enhance collaboration	**No Impact**				**Very High Impact**
	1	**2**	**3**	**4**	**5**
Existence and interest of local venture capital participation	□	□	□	□	□
Availability and interest of international venture capital participation	□	□	□	□	□
Availability and quality of current technology	□	□	□	□	□
The quality of local education system and training availability	□	□	□	□	□
Active participation in social networking activities	□	□	□	□	□
Existence and quality of local infrastructure	□	□	□	□	□
Active support from local intermediaries to support the commercialisation process (e.g. role of Multimedia Dev. Corporation, Biotech Corporation, MIDA & others)	□	□	□	□	□
Clear direction and effective policy on intellectual property right	□	□	□	□	□
Degree of competence and commitment of trust among collaborators	□	□	□	□	□
Quality of local entrepreneurs (e.g. behaviour, skills, experience)	□	□	□	□	□
Numbers of collaborations contracts or projects involves	□	□	□	□	□
Others:________________________ *(please specify)*	□	□	□	□	□

Section 4: Comments and/or feedback of respondents

4.1 What would be your comment (if any) in relations to the role of collaboration between universities-industry-governments to support firm formation in Malaysia?

____

____

THANK YOU!

APPENDIX 4

CONSENT LETTER TO CONDUCT RESEARCH IN MALAYSIA

UNIT PERANCANG EKONOMI
Economic Planning Unit
JABATAN PERDANA MENTERI
Prime Minister's Department
BLOK B5 & B6
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62502 PUTRAJAYA
MALAYSIA

EPU
ECONOMIC PLANNING UNIT
PRIME MINISTER'S DEPARTMENT, MALAYSIA

Telefon : 603-8872 3333

Ruj. Tuan:
Your Ref.:

Ruj. Kami:
Our Ref.: UPE: 40/200/19/2830

Tarikh:
Date: 18 July 2011

ZATUN NAJAHAH MOHD YUSOF
25 Annfield Garden
Stirling, Scotland, U.K.
FK8 2BJ
Email: znm1@stir.ac.uk

APPLICATION TO CONDUCT RESEARCH IN MALAYSIA

With reference to your application, I am pleased to inform you that your application to conduct research in Malaysia has been *approved* by the **Research Promotion and Co-Ordination Committee, Economic Planning Unit, Prime Minister's Department.** The details of the approval are as follows:

Researcher's name :	**ZATUN NAJAHAH MOHD YUSOF**
Passport No. / I. C No:	**770204-01-5660**
Nationality :	**MALAYSIAN**
Title of Research :	**"CLUSTER FORMATION IN MALAYSIA: THE ROLE OF UNIVERSITY-INDUSTRY-GOVERNMENT RELATIONSHIP"**

Period of Research Approved: **3 MONTHS**

2. Please collect your Research Pass in person from the Economic Planning Unit, Prime Minister's Department, Parcel B, Level 4 Block B5, Federal Government Administrative Centre, 62502 Putrajaya and bring along two (2) passport size photographs. You are also required to comply with the rules and regulations stipulated from time to time by the agencies with which you have dealings in the conduct of your research.

3. I would like to draw your attention to the undertaking signed by you that you will submit without cost to the Economic Planning Unit the following documents:

a) A brief summary of your research findings on completion of your research and before you leave Malaysia; and

b) Three (3) copies of your final dissertation/publication.

4. Lastly, please submit a copy of your preliminary and final report directly to the State Government where you carried out your research. Thank you.

Yours sincerely,

Munirahmanan

(**MUNIRAH ABD. MANAN**)
For Director General,
Economic Planning Unit.
E-mail: munirah@epu.gov.my
Tel: 88725281/88725272
Fax: 88883961

ATTENTION

This letter is only to inform you the status of your application and **cannot be used as a research pass**.

APPENDIX 5

SEMI-STRUCTURE INTERVIEW QUESTIONS

Profile of Interviewee:

Name	
Organisation	
Designation	
Date of Interview	
Time of Interview	
Venue	
Tel./Fax Number	
E-mail	
Address	
Notes	

INTERVIEW QUESTIONS

Introduction

1. How long have you been in this position and this agency in particular?
2. Based on your experience, what do you think about working in this organisation?

About Multimedia Super Corridor (MSC) Malaysia

1. What do you think about the MSC Project and in your opinion, has the MSC achieved a cluster status?
2. Do you think the world leading technology position has been achieved through MSC project?
3. In your opinion, has the technology position been successful in generating innovation based business expansion?
4. Within the complex system actors such as university, industry and government, who do you think contributes more in the development of MSC project?
5. What make MSC different from other high technology cluster for example Silicon Valley in US, Cambridge Fen in UK and Sophia-antropolis in France?
6. Do you think the MSC Project is worth of investment or valuable investment (why/why not)?

About cluster determinants and relationship between university-industry-government

1. What do you think about impact of having close relationship and/or active social interaction with government's agencies to support technology firms?
2. What do you think about impact of having close relationship and/or active social interaction with industry to support technology firms?
3. What do you think about impact of having close relationship and/or active social interaction with university to support technology firms?
4. Who do you think have the autonomy/dominant in this relationship (university, industry or government)? Why
5. At current situation, do you think local university is ready to become entrepreneurial university?
    a. Yes/No – why
    b. What are the milestones required to reach entrepreneurial university?

6. What problems do you foresee in having close relationship and/or social interaction with university-industry government?
7. Are the following factors an issues or problem in developing a close collaborative relationship?
   a. Bureaucracy
   b. Process of financing i.e. starts from submit application to receiving funds
   c. What about the process to achieve mutual agreement between collaborators?
   d. What about issues on inexperience and difficult in connecting to market
   e. What about the issues of availability of local skills?
   f. Does the influence of foreign and/or large firms an issue in collaborative relationship?
   g. What about the culture issue including trust?
8. What need to be done to address the issues/problems mentioned before?
9. Do you agree that the role of university-industry-government relationship could support the creation and development of technology-based firms in Malaysia?
10. Last but not least, do you have any other point to add-on or comment?

END SESSION

APPENDIX 6

RELIABILITY TEST OF VARIABLES

Reliability Statistics of Cluster Factor Conditions

Cronbach's Alpha	N of Items
.785	12

Reliability Statistics of Local Factors Conditions

Cronbach's Alpha	N of Items
.821	18

Reliability Statistics of Value to Collaborative Partner

Cronbach's Alpha	N of Items
.758	10

Reliability Statistics of Motives of Collaboration

Cronbach's Alpha	N of Items
.822	16

Reliability Statistics of Barriers of Collaborations

Cronbach's Alpha	N of Items
.889	17

Reliability Statistics of Potential Collaborations

Cronbach's Alpha	N of Items
.786	11

APPENDIX 7

MANN-WHITNEY TEST RESULT: COMPARING ICT AND BIOTECH INDUSTRY

Note:
** Significant at 10% level (p < 0.1), ** Significant at 5% level (p < 0.05), *** Significant at 1% level (p < 0.01)*

- **Local Factors**

Local Factors	Mean Rank ICT (n=58)	Mean Rank Biotech (n=30)	Mann-Whitney U	Wilcoxon W	*z* value	*p* value
Communication system e.g. internet connection	44.60	44.30	864.000	1329.000	-0.057	0.955
Cost to employ locals in your industry	44.61	44.28	863.500	1328.500	-0.063	0.950
Mail and parcel delivery	44.79	43.93	853.000	1318.000	-0.162	0.871
Work ethic of related people in your industry	45.52	42.53	811.000	1276.000	-0.561	0.575
Quality of local skills in your industry	42.54	48.28	756.500	2467.500	-1.047	0.295
Organisation's current geographic location in your industry	43.76	45.93	827.000	2538.000	-0.396	0.692
Availability of local amenities	45.82	41.95	793.500	1258.500	-0.707	0.480
Quantity of local skills in your industry	43.42	46.58	807.500	2518.500	-0.593	0.553
Health care services	45.66	42.25	802.500	1267.500	-0.628	0.530
Road and transport system e.g. train, bus and etc.	43.97	45.53	839.000	2550.000	-0.287	0.774
Availability to access finance for your industry	47.50	38.70	696.000	1161.000	-1.590	0.112
Availability of venture capital to invest in your industry	46.78	40.10	738.000	1203.000	-1.206	0.228
Role of local university to facilitate knowledge transfer activities	43.38	46.67	805.000	2516.000	-0.596	0.551
Role of local research institution to facilitate knowledge transfer activities	42.78	47.83	770.000	2481.000	-0.921	0.357

- **Collaborating Partner**

Collaborating Partner	Mean Rank ICT (n=58)	Mean Rank Biotech (n=30)	Mann-Whitney U	Wilcoxon W	*z* value	*p* value
Customers	42.64	48.10	762.000	2473.000	-1.038	0.299
Government Agencies	44.03	45.42	842.500	2553.500	-0.259	0.796
Suppliers	41.38	50.53	689.000	2400.000	-1.768	0.077*
Foreign firms	49.17	35.47	599.000	1064.000	-2.547	0.011
Financial institution	44.23	45.02	854.500	2565.500	-0.144	0.886
Local firms	45.60	42.37	806.000	1271.000	-0.601	0.548
Intermediaries	41.53	50.25	697.500	2408.500	-1.605	0.108
Research Institution	42.09	49.17	730.000	2441.000	-1.282	0.200
University	41.70	49.92	707.500	2418.500	-1.472	0.141

- **Possible Elemets to Enhance Collaboration**

Potential elements to enhance collaboration	Mean Rank ICT (n=58)	Mean Rank Biotech (n=30)	Mann-Whitney U	Wilcoxon W	*z* value	*p* value
The quality of local education system and training availability	45.52	42.53	811.000	1276.000	-0.555	0.579
Availability and quality of current technology	45.73	42.12	798.500	1263.500	-0.685	0.494
Existence and quality of local infrastructure	48.33	37.10	648.000	1113.000	-2.110	0.035**
Active support from local intermediaries to support the commercialisation process (e.g. role of Multimedia Dev. Corporation, Biotech Corporation, MIDA & others)	44.38	44.73	863.000	2574.000	-0.065	0.948
Quality of local entrepreneurs (e.g. behavior, skills, experience)	46.69	40.27	743.000	1208.000	-1.189	0.235
Existence and interest of local venture capital participation	43.42	46.58	807.500	2518.500	-0.586	0.558
Active participation in social networking activities	45.37	42.82	819.500	1284.500	-0.468	0.640
Degree of competence and commitment of trust among collaborators	45.46	42.65	814.500	1279.500	-0.533	0.594
Availability and interest of international venture capital participation	46.36	40.90	762.000	1227.000	-1.015	0.310
Clear direction and effective policy on intellectual property right	43.66	46.13	821.000	2532.000	-0.453	0.651
Numbers of collaborations contracts or projects involves	47.54	38.62	693.500	1158.500	-1.623	0.105

- **Barriers of Collaboration**

Problem or barrier of collaboration	Mean Rank		Mann-Whitney U	Wilcoxon W	z value	*p* value
	ICT (n=58)	Biotech (n=30)				
Bureaucratic and too many authorisation causes longer time to start collaboration work	41.22	50.83	680.000	2391.000	-1.780	0.075*
Longer process of financing start from submit application to receiving the funds	42.48	48.40	753.000	2464.000	-1.085	0.278
Limitation of local skills contribution in collaboration	43.80	45.85	829.500	2540.500	-0.377	0.706
Inexperience and difficulty in connecting to market (e.g. marketing and commercialisation activities)	42.66	48.07	763.000	2474.000	-1.005	0.315
Limitation of local technology contribution in collaboration	42.89	47.62	776.500	2487.500	-0.871	0.384
Time consuming to achieve mutual agreement between collaborators	42.77	47.85	769.500	2480.500	-0.955	0.340
Lack of R&D equipment and expertise	42.53	48.30	756.000	2467.000	-1.055	0.292
Different interest and objectives of collaborators	43.45	46.53	809.000	2520.000	-0.559	0.576
Different interest of venture capitalist /investor	42.34	47.15	760.500	2413.500	-0.877	0.380
The influence of external/foreign organisation or large organisation in business environment.	45.91	41.78	788.500	1253.500	-0.750	0.453
Inability to share the information with others except with close friends / contacts	40.91	51.45	661.500	2372.500	-1.938	0.053*
Too much secrecy and curiosity in sharing information	43.39	46.65	805.500	2516.500	-0.593	0.553
Priority of collaboration is just to get self-recognition and sense of achievement	46.19	41.23	772.000	1237.000	-0.898	0.369
Lack of understanding in norms, values, practices and environment of collaborators	45.33	42.90	822.000	1287.000	-0.447	0.655
Geographic location of collaborators	42.87	47.65	775.500	2486.500	-0.865	0.387
Unclear policy and guidelines of using patent	43.88	45.70	834.000	2545.000	-0.328	0.743
Gift-giving or reward practices (favour to the other parties when sharing or passing new method or process or formula)	43.86	45.73	833.000	2544.000	-0.338	0.735

APPENDIX 8

CODING (NODE) SUMMARY FROM QSR NVIVO 10

Node Summary

Cluster determinants and university-industry-government collaborative relationship in MSC
18/09/2013 14:42

Source Type	Number of Sources	Number of Coding References	Number of Words Coded	Number of Paragraphs Coded	Duration Coded

Node

Nickname: Nodes\\Autonomy of relationship

Document	18	25	1,279	26	

Nickname: Nodes\\Bureaucracy

Document	18	21	1,218	21	

Nickname: Nodes\\Business behaviour

Document	7	8	499	9	

Nickname: Nodes\\Cluster

Document	19	128	9,110	142	

Nickname: Nodes\\Collaboration capability

Document	17	45	2,648	46	

Nickname: Nodes\\Collaboration impact

Document	20	100	8,023	106	

Nickname: Nodes\\Collaboration process

Document	17	37	3,062	38	

Nickname: **Nodes\\Continuity of project in cluster(Nodes)**

Document	6	8	609	9

Nickname: **Nodes\\Corruption Issues**

Document	1	1	16	1

Nickname: **Nodes\\Culture - trust**

Document	18	36	1,848	37

Nickname: **Nodes\\Education system**

Document	5	5	594	7

Nickname: **Nodes\\Entrepreneurial university**

Document	19	35	2,903	38

Nickname: **Nodes\\Financing**

Document	18	40	3,271	40

Nickname: **Nodes\\Foreign & large firm influence**

Document	15	19	1,213	19

Nickname: **Nodes\\Industry related curriculum at university**

Document	10	12	956	12

Nickname: **Nodes\\IP issues**

Document	11	14	1,226	14

Nickname: **Nodes\\Local skill**

Document	19	62	5,242	71

Nickname: **Nodes\\Major contributor in cluster development**

Document	19	20	1,965	23

Nickname: **Nodes\\Market connection**

Document	16	31	3,459	33

Nickname: Nodes\\Networking benefits

Document	8	10	725	10

Nickname: Nodes\\Objective collaboration

Document	19	51	4,480	57

Nickname: Nodes\\Policy & regulation

Document	15	30	1,667	31

Nickname: Nodes\\Political influence

Document	6	7	543	7

Nickname: Nodes\\R&D

Document	12	29	3,655	35

Nickname: Nodes\\Relationship with government

Document	15	15	1,305	16

Nickname: Nodes\\Relationship with industry

Document	19	19	1,940	23

Nickname: Nodes\\Relationship with university

Document	19	19	2,302	22

Nickname: Nodes\\Research value

Document	13	17	2,013	18

Nickname: Nodes\\Role of government

Document	19	46	3,301	46

Nickname: Nodes\\Role of industry

Document	14	24	2,833	27

Nickname: Nodes\\Role of intermediaries

Document	16	35	3,163	42

Nickname: Nodes\\Role of university

Document	17	63	6,652	72

Nickname: Nodes\\Strategy for collaboration

Document	8	15	1,111	20

Nickname: Nodes\\Technology Availability

Document	16	27	1,844	27

Nickname: Nodes\\Technology transfer

Document	6	10	972	12

Reports\\Node Summary Report