The Roles and Functions of a Science Park in a Mauritius

A Study by the

Mauritius Research Council

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Foreword

The idea of establishing a Science Park in Mauritius has been put forward by a number of protagonists over the years. The initiative has been motivated by the need to simulate other developing nations by capitalizing on the potential of exploiting science and technology for the economic development of the country. Several models of Science Park have been evoked recently and a number of consultancies carried out in order to formulate the right model for Mauritius; an island with unique characteristics in terms of population and market needs. However, no definite model could be adopted due to its incompatibility within the Mauritian context.

It was against the above backdrop that the Mauritius Research Council, under the aegis and support of the Ministry of Industry Science and Research, set out to undertake the present study. The main objective was to define the roles, functions and operation of a Science Park that could enhance the competiveness of Mauritius. The approach adopted was a multi-stakeholder consultation through both qualitative and quantitative surveys as well as drawing extensively on the extant literature.

Abstract

Science Parks can be described as a “triple helix” involvement of academia, industry and government, each playing a complementary role with a view to transforming technologically innovative ideas into enterprises. In so doing, regions can be made more prosperous and countries enhance their competitive advantages while creating jobs and wealth.

The extant literature shows that there is no consensus on the existence of a common framework within which Science Parks can be evaluated; the main reason being the varied purposes for which they were set up. As a result, best practices are difficult to be established and consequently a model functioning well in one part of the world is not transferrable to other parts.

The present work aims at filling a gap in the literature by introducing a theoretical framework based on Porter’s diamond model of competiveness and within which the setting up of a Science Park can be examined. In particular, the study uses the economic setting of the island of Mauritius as a basis to evaluate the potential roles of a Science Park on the competiveness of the country. Indeed the present study is among the first to explore the potential impact of a Science Park within the context of a small island developing state with its unique specificities in terms of small distant market and limited human and technological capital.

The methodology used to define the potential roles of the Science Park is based on qualitative in-depth interviews of key decision makers on the island whereas the desired services to be provided by the Science Park are determined through a quantitative survey of the business sector on the island. The results indicate that a Science Park would indeed improve the technological absorption capacity of the

island leading to enhanced exportation. However, its setting up requires a set of enabling factors.

The study concludes by determining the potential roles of the Science Park as well as a set of prioritized services it has to deliver, together with its governance, mode of financing and its structural form. A major finding of the study is that, in the context of the small island state, a ‘General Purpose’ Science Park, catering for both the manufacturing and ICT sectors, is preferred as oppose to an ‘industry specific’ Park.

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Chapter 1: Introduction

1.0 Background

Innovation has become of key interest to many countries seeking development that goes beyond the traditional incremental economic evolution. Porter (1990) describes innovation as necessary to "*sustain the competitive advantage of firms*". In the last two decades, most countries in the world have developed "*national innovation systems*" with a view to promoting innovation both at the firm level and at the country level. In a study of 15 countries representing both advanced and less advanced nations, Nelson (1992) compared the respective national innovation systems and concluded that while science and technology are dominant features within the system, there are considerable systemic variations in the systems because "*countries differ in their traditions, ideologies and beliefs about appropriate roles of government*". However, while innovation systems across countries differ, they also consist of basic elements or sub-systems which are common in the value chain. This chapter introduces some of the basic elements of the innovation system while focusing on the roles of Science Parks in the creation of new technology-based enterprises. The Chapter ends by postulating the research question which emanates from the proposal to set up a Science Park in the island of Mauritius.

1.1 National Innovation System

While there is no "*single accepted*" definition of national innovation system, Freeman (1987) had proposed the following: "*The network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies*"(OECD,1997). The concept of National innovation systems appeared in the late 1980's and "*this new framework suggests that the research*

system's ultimate goal is innovation, and that the system is part of a larger system composed of sectors such as government, university and industry" (Godin, 2009).

New promising fields such as nanotechnology and bioinformatics are emerging as a result of the fusion of several scientific disciplines which traditionally were treated as isolated subjects (Wonglimpiyarat, 2006). Nowadays, the focus is on "*multi-disciplinary*" as scientists and others realize that innovation increasingly means the coming together of many disciplines and the need to work in teams. Moreover, universities are under increasing pressure to venture outside their academic walls and transform their innovative concepts into commercial products and services in order to be financially viable (Amirahmadi & Saff, 1993). Many countries are nowadays formulating new and revising old policies to enable the setting up of National Innovation Systems which will foster and promote innovation (OECD, 1997). In most of these national innovation systems, a major catalyst is the setting up of technology transfer mechanisms which are also conducive to the transformation of technological ideas into enterprises (Rasmussen et al.,2006). These mechanisms vary in details but most can be categorized as being either a science park or a business incubator as described below.

1.2 Science Park

While there is no single definition of a science park, Amirahmadi & Saff (1993) describe science parks as attractive locations in proximity to research establishments, which are offered to firms dealing in innovative technology areas. Science park has also been considered as "*property based organizations with*

identifiable administrative centers focused on the mission of business acceleration through agglomeration and resource sharing" (Phan et al., 2005). A popular description is that the main function of the science park is to transform innovative concepts developed from within academia into commercial enterprises, thereby creating wealth and jobs for the country. In essence, the Science Park can act as a facilitator, a market analyst and, sometimes, even as a venture capitalist, in order to maximize the nurturing of the innovation into an enterprise. The major stakeholders in a Science Park have been described as the "*triple helix*" as they comprise the government, the private sector and academia. Successful operation of a Science Park very often depends on the synergy created by these three stakeholders. Several successful models of Science Parks exist, mostly in the developed countries. The most famous being the Silicon Valley in the US (Wonglimpiyarat, J., 2006).

1.3 Business Incubator

Business incubators have been described as "*assisting emerging ventures by providing support services in developing their businesses*", Grimaldi and Grandi (2005). While playing a similar role to that of a Science Park, business incubators are in general much smaller units than Science Parks and not necessarily located in the proximity of a university or research institution. Grimaldi and Grandi (2005) also describe several models of incubators varying from university led ones to independent private incubators which are profit driven. In addition, many incubators are sector specific. For example, some incubators only cater for internet based businesses (Chinsomboon, 2000). However, not all incubators are effective and performing. Ratinho & Henriques (2009) describe how business incubators only

bring “*a modest contribution to economic growth in Portugal*”. Many Science Parks also offer business incubator facilities alongside other services.

1.4 Access to Venture Capital

Howells & Michie as cited by Seyoum (2004) are of the view that access to funds is primordial for the commercialization of new ideas. However, access to funds remains a major constraint faced by many start-up organizations. Wright et al., (2006) suggest that there exists “*a gap between the demand for finance from entrepreneurs involved in new ventures and the willingness of suppliers to provide this finance*”. The same authors advance several reasons for the existence of this ‘*market failure*’. These include the lack of incentives from the policy-makers for high-risk venture participation from the private sector. In addition, the procedures used by venture capitalists to screen and assess proposals and to determine the stage at which they invest may be at the detriment of the entrepreneurs (Wright et al., 2006). Successful Science Parks and incubators are those which also facilitate access to venture capitalists as demonstrated in the Nordic countries (Rasmussen et al., 2006). In many developing countries such as China, Malaysia and Taiwan (Kroll & Liefner, 2008, Ramasamy et al,. 2004, Lai & Shyu, 2005), government plays an important role in providing financial access to start-up companies, thus minimizing the risk at the early stage in the business cycle.

1.5 Intellectual Property Rights

An important consideration in the innovation system is the legal framework that determines Intellectual Property Rights (IPR). The legal rights of the researcher or

the research institute or the research funding agency with regard to the ownership of the knowledge that could emanate from the research have to be clearly established within the innovation system. Many countries have put in place clearly defined IPR policies. In some countries such as the US, any IPR emanated from research funded by the state can belong to the researcher and the research institute according to the Bayh-Dole Act of 1980 and the Federal Technology Transfer Act of 1986 (Wonglimpiyarat, J., 2006). In the Nordic countries such as Finland and Sweden, clear IPR policies have been established which determine the roles and benefits of the stakeholders in venturing into research activities. However, in many countries including Mauritius, the rules governing IPR are either detrimental to the growth of research activities (MRC, 2000) or not clearly elaborated.

1.6 Science Parks in Developing Countries

It is generally recognized that those countries which have invested in science and technology are nowadays reaping the benefits of these investments in terms of wealth and job creation. Whilst this is the case for most developed nations, many developing and some under-developing countries are struggling to emulate the richer countries by introducing the concept of Science Parks or Business Incubators. Singapore (Koh et al., 2005), Malaysia (Ramasamy et al,. 2004,), Taiwan (Yang et al., 2009), Korea (Seo, 2006) and South Africa (Innovation Hub, 2009), among many other countries have set up Science Parks and incubators with varying degrees of success. Even the Singaporean Science Park which is based on the American and European model has yet to be very effective and its contribution is described by Koh et al.,(2005) as "*relatively modes*t". Many Science Parks and incubators modeled on the traditional "*western' style*" are yet to bear fruits in the developing countries.

Several reasons are being postulated, varying from lack of high-skilled human resources, poor access to venture capital funds, limited market size, inability to attract multi-national companies, and even cultural differences as well as "*aversion to risk taking"* by the local entrepreneurs and scientists (Koh et al., 2005, Ramasamy et al., 2004, Amirahmadi & Saff, 1993, Bakouros et al.,2002, Ratinho & Henriques, 2009). Indeed, as reported by Phan et al., out of the 13 Science Parks created in late 1980 in India, only one is in existence today.

1.7 The Island State of Mauritius

Located in the middle of the Indian Ocean, the island of Mauritius comprises a multi-cultural and multi-ethnic population of about 1.3 million. Since its independence from England in 1968, it has made significant progress from having no natural resources and relying entirely on the mono-crop industry (sugar-cane) to a diversified economy which includes Agriculture, Tourism, Textile and the financial sector, although ICT is expanding rapidly to become a major sector. Mauritius is now classified as a 'Middle-Income' developing country, and "*ranks, on the basis of the recent Human Development Index for 173 countries, 67th globally, 40th among developing countries and second in Africa"* (Mauritius Portal, 2008). Its GDP per capita is about $7,000 USD and the economy has experienced growth of 5% over the last few years. However, the impact of globalization and the liberalization of trade call for concern as "*Sustaining the growth momentum well into the future is a major challenge …. and reforms are required domestically to arrest fiscal decline, achieve growth in labor and total factor productivity and address the issues of pockets of poverty and an ageing population"* (Mauritius Portal, 2008).

The country spends about 10.6 % of its GDP on education and about 0.3% on Research & Development (R&D). Although, it has the basic research infrastructure, universities and research institutions, science and research have yet to develop to an extent where they are seen to contribute to the economic development of the country (MRC, 2000). Over 70% of the students in secondary schools stop doing scientific studies at the age of 14 and very few will eventually undertake scientific research. Brain drain is also an issue which is of concern to the authorities (MRC, 2000). There is also little interaction between industries and research at the universities (MRC, 2000). With regard to IPR issues, the existing legal framework postulates that all IPR emanating from Government funding research belongs to the Government, except for those which have special waiver from the Minister concerned (MRC Act, 1992). This is a serious impediment which needs to be addressed so that research can flourish on the island. The present analysis of the proposal to create a Science Park in Mauritius takes into account all these concerns.

1.8 The Research Question and Objectives

In the specific setting of a geographically remote, small island state such as Mauritius, with little natural resources and limited human resources, it is argued whether science and technology in the form of a Science Park and/or an incubator can contribute to economic development. Whilst it is generally believed that a Science Park will be beneficial to Mauritius it is, however, not clear as to what the precise roles and functions of the Science Park should be in order to avoid mistakes made in other developing countries. The overall aim of the study is to determine the characteristics of a model for a performing Science Park operating within the context

of a small island developing state such as Mauritius. In this respect, the specific research question is:

What should be the roles and functions of a performing Science Park which would contribute to the industrial / technological development of the island state of Mauritius?

In particular, the objectives are as follows:

- Contextualize the setting up of a Science Park in Mauritius within a theoretical framework of global competiveness enhancement;
- Use the theoretical model to identify potential roles of the Science Park to improve the competitiveness of Mauritius;
- Undertake a qualitative survey of key people and decision makers to validate these potential roles as well as identifying enabling factors for the setting up of the Science Park;
- Using the potential roles of the Science Park as a basis, undertake a quantitative survey of enterprises operating in Mauritius to formulate a prioritized set of functions that the Science Park ought to provide in order to satisfy the business community's needs and aspirations and thereby contributing the industrial/technological development of Mauritius.
- From the results of the quantitative survey, also propose a form of Governance for the Science Park and a mode of financing that would suit the context of Mauritius.

1.9 Report Layout

The presentation of the report follows the order of the above objectives of the study. The next Chapter 2 describes an in-depth literature review on Science Parks, focusing on characteristics such as the mission and purposes, the services, the social aspect, the governance and the performance. Chapter 3 elaborates on the research strategy adopted to address these objectives and thus the research question. In Chapter 4, a theoretical framework within which the impact of the Science Park on competitiveness is discussed and used to derive a set of core questions pertaining to the potential roles of the Science Park. Chapter 5 describes a qualitative survey comprising in-depth interviews which is used to seek answers to the 10 core questions. This is complemented in Chapter 6 by an extensive quantitative e-mail survey of enterprises to formulate the functions and services to be provided by the Science Park within the context of Mauritius. Finally, Chapter 7 concludes the study by defining the roles and functions of the Science Park and also makes recommendations for further research.

Chapter 2: Literature Review

2.0 Introduction

The previous chapter already drew on the extant literature to show the importance of a Science Park in the value chains of an innovation system. An underlying objective of the present study is to identify best practices in Science Parks with a view to replicating these in the small island state of Mauritius. To that effect, the literature survey covered Science Parks operating worldwide but focusing on the developing countries. Phan et al., (2005) scrutinized the literature on Science Parks and Incubators in terms of four variables: the Science Parks and incubators themselves, the enterprises located within the parks and incubators, the entrepreneurs, and the systemic level. A major conclusion of the work of Phan et al., (2005) is that there is no framework, either theoretical or empirical within which to examine the relationships and dependence of these variables. These views are also supported by Amirahmadi & Saff, (1993). As such, the performance of Science Parks and incubators are difficult to be compared and assessed. Indeed, one output of the present study is the formulation of a framework for the feasibility of the setting up of a Science Park.

In this chapter, the salient aspects of Science Parks and the environment within which they are created as well as that in which they operate are discussed in relation with previous studies undertaken by researchers. First, a common definition of Science Park is adopted before exploring the substantial growth of Science Parks and incubators across the world. To comprehend this growth, the rationales behind these Parks and incubators need to be understood. This leads to a discussion on the varying missions and purposes of Science Parks and as a result, the attributes of the varied services offered by the Parks and incubators. Without people, Parks are

"*virtual spaces*" and thus the discussion also includes the important role of human capital, communications and relationships which are required to make Science Parks effective. Having elaborated on the functions of the Science Parks, the chapter then describes the many forms of governance of Science Parks and the corresponding financing modes. Measurements of performance of Science Parks are then discussed and the difficulty in defining a common methodology for performance assessment is elaborated upon.

Finally, the Chapter highlights some gaps in the literature on Science Parks and illustrates how the present study fill-in these gaps by providing additional knowledge on Science Parks, particularly in the context of a small island state.

2.1 Definition of Science Parks

While there is no commonly agreed definition for a Science Park, terms such as, technology parks, innovation parks and business parks and incubators are used interchangeably. To provide "*definitional clarity*" Quintas et al. use the following criteria as established by the UK Science Park Association (UKSPA):

"The science park is a property based initiative which:

- *Has formal operational links with a university or other higher educational or research institution;*
- *Is designed to encourage the formation and growth of knowledge based business and other organization normally resident onsite;*
- *Has a management function which is actively engaged in the transfer of technology and business skills to the organizations on site."*

As far as possible, the above definition for a Science Park is used in this study and as such incubators are included in this definition.

2.2 Growth of Science Parks & Incubators

Amirahmadi & Saff (1993) describe how, during the economic recession of the 1980's, "*many policymakers facing decreasing revenues and rising unemployment looked to technology-led development to pump new life into their sagging regional and national economies*". The creation of Science Parks was one of the most significant ways to promote this high-tech strategy. In particular, with the passing of the Bayh-Dole Act of 1980 in the USA, which granted Intellectual Property Rights to research institutions and universities which undertake research through government funding, there has been a surge in the number of Science Parks created in the USA (Siegel et al., 2003); the most well known being Silicon Valley. During the same time, across into Europe, the pace in creating Science Parks was set by the UK, where universities saw Science Parks as a revenue generating mechanism to assist them at a time when government funding to universities was being drastically cut (Quintas et al., 1992). Subsequently, Science Parks and incubators started to mushroom all over Europe including Italy, France and Spain. In the 1990's the concept reached the Asian countries, primarily China, Taiwan, Korea, Singapore and Malaysia although Science Parks existed much earlier in Japan; the first, Tsukuba Science City was built in 1970 (Phan et al., 2005).

In 2009, the UK Science Park Association, UKSPA (2009) boast some 90 Science Parks as members, comprising of about 3500 tenant companies and providing some 75,000 jobs in a number of cutting edge technological fields. The charts below illustrate the growth on this industry in the UK and similar growths are reported in other countries.

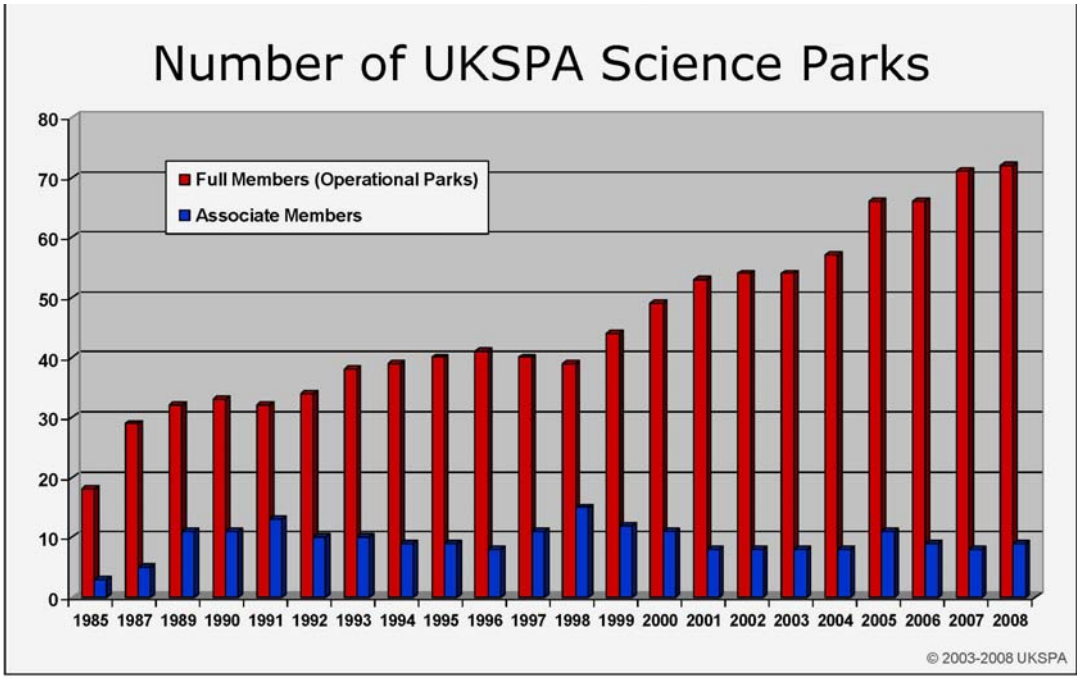

Figure 2.0 Growth of Science Parks in the UK (Source: http://www.ukspa.org)

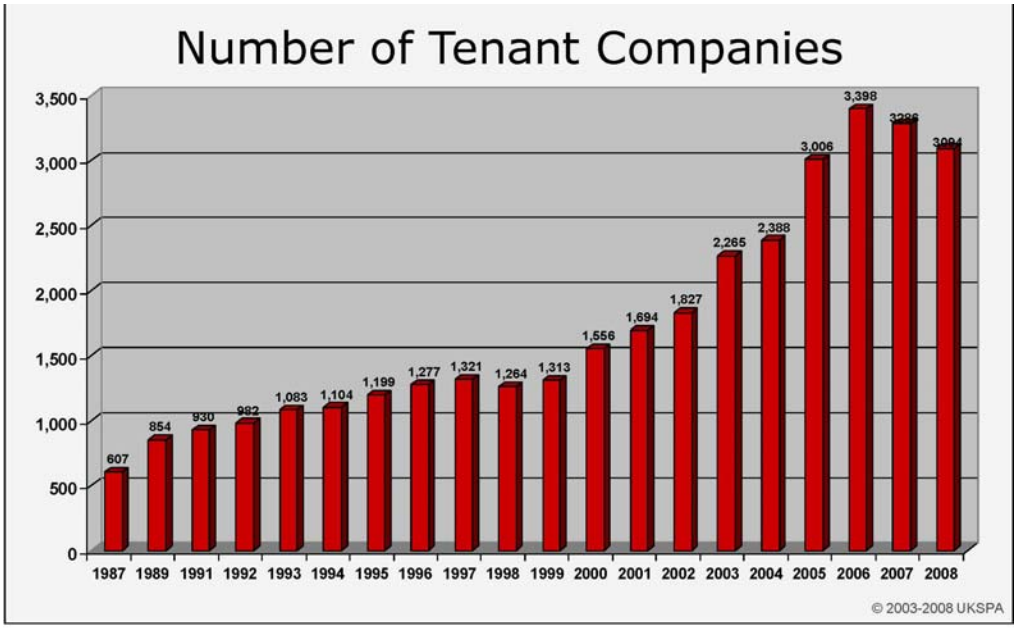

Figure 2.1 Number of Tenant Companies (Source: http://www.ukspa.org)

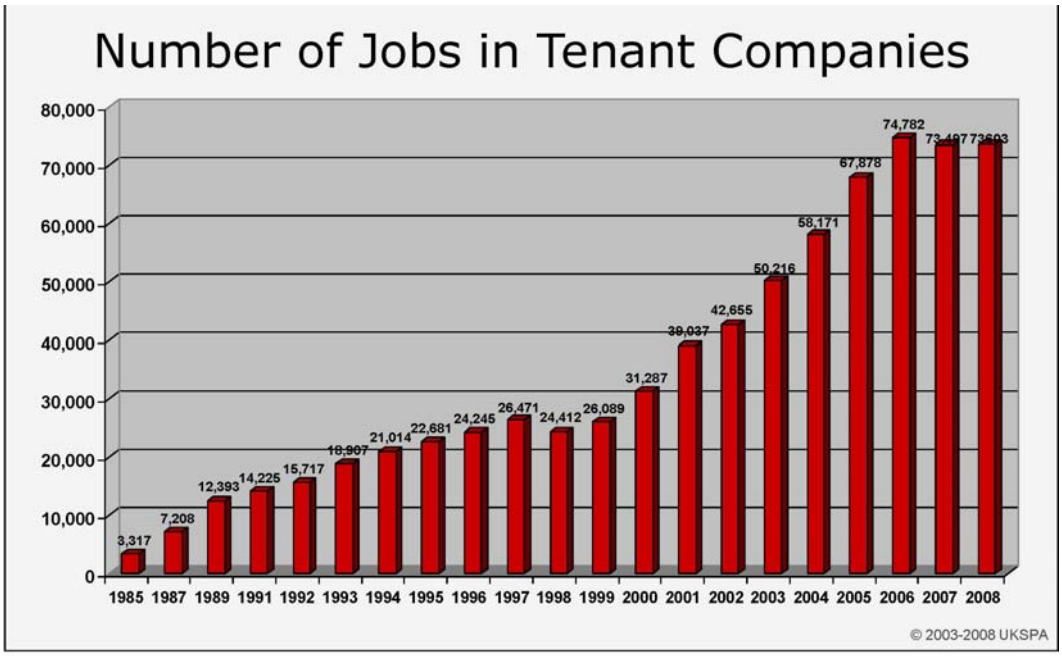

Figure 2.2 Jobs in Tenant Companies (Source: http://www.ukspa.org)

The UK Business Incubation, UKBI (2009) claims some 300 incubator members grouping together over 12,000 small enterprises. Today, the worldwide incubator industry is approaching 5000, starting with less than 10 in 1985 (Bollingtoft & Ulhoi, 2005) as shown below:

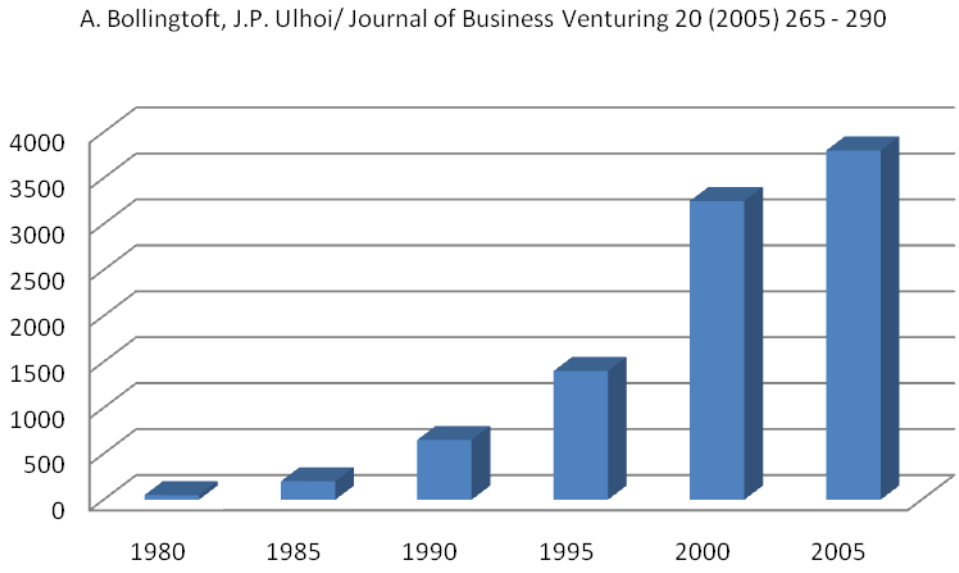

Figure 2.3 Growth of the world-wide incubator industry (Source: Colin Barrow, 2001, cited by Bollingtoft & Ulhoi, 2005)

A significant presence of Science Parks on the African continent has yet to be registered. The main one, “The Innovation Hub” is a recent development (www.theinnovationhub.com) and is based in South Africa. However, many African countries including Mauritius are nowadays contemplating the idea of introducing a Science Park and hence this study for Mauritius.

2.3 Mission and Purpose

Although the prime purpose of Science Parks and incubators is to create wealth and jobs through innovative high-tech businesses, the mission of individual Science Parks vary from within countries and across nations. Amirahmadi & Saff (1993) are of the views that there is no “*singular rationale for the establishment of Science Parks*”. Different countries have their own perceptions as to how the Science Park would contribute to economic development. In Japan, Science Park is a way of promoting regional equality while in Singapore it is a way to promote technology-led development (Amirahmadi & Saff, 1993). Moreover, in Malaysia, Science Park is a “*signaling motive*” transmitted to multinationals to signify that the country is “*technology ready”* (Koh et al., 2005). Even within countries, Science Parks exhibit different mandates. The Cambridge Science Park in the UK focuses on basic research thus capitalizing on its proximity with the science laboratories of Cambridge University. On the other hand, Bradford City Council in the UK created its Science Park because it was “*just an idea*” (Amirahmadi & Saff, 1993). In addition, Science Parks can have a region specific role such as that of Sophia-Antipolis in France which, according to Perrin (1988) as cited by Amirahmadi & Saff (1993), was created in the wake of a “*territorial type*” technology policy aimed at developing a particular region.

Furthermore, Science Parks and incubators can be sector specific and focus on particular technology only such as the nurturing of only "*Internet-based*" enterprises (Chinsomboon, 2000). Being industry specific can help to attract start-ups by clearly defining the profile of the new incoming venture as well as developing specific skills and know how in the sector (Grimaldi &Grandi, 2005).

An important aspect in the development of Science Parks has been the impact of military or defense spending. Amirahmadi & Saff (1993) report that in the US, some Science Parks have benefited because of their proximities with "*Federal Agencies*", and federal spending on nuclear research and medical technology.

The involvement and the presence of Multi-National Companies (MNC) in Science Park can also influence the mission and development of Science Parks. In Singapore and Malaysia, plethora of incentives is offered for MNC's to locate their R&D activities within the park (Koh et al., 2005).

Finally, the mission of the Science Park or incubator may be influenced by the market to be served. Grimaldi & Grandi (2005) describe how some Science Parks and incubators only target the local market while others aim at attracting companies country-wide as well as internationally. The choice is an important one as it dictates the functions and services to be offered by the organization.

2.4 Services offered

The services offered by Science Parks and Incubators can be classified as those which are "intangibles" and those which are "tangibles". These services depend on the mission of the Science Park as described above. Tangible services include

spaces, offices, and communications, among others. In some cases, the newly created firms are provided with affordable rents and equipments are available on a shared basis. In the event of the need for sophisticated equipments or access to laboratories, then formal links with universities or research institutions are established. Secretarial services are also made available (Bollingtoft & Ulhoi, 2005). Intangibles would include transfer of competencies and knowledge-based services (Grimaldi & Grandi, 2005). These involve assistance in business planning and development of market plan. Some Science Parks and incubators also provide assistance to day-to-day management of the business (Chinsomboon, 2000). An important service offered by some but not all Science Parks is access to venture capitalists. This can take many forms, depending on the mode of finance of the Science Park and is discussed later.

Some university based Science Parks and incubators also offer faculty consultants, student employees, library services laboratory equipment and main frame computing (Grimaldi & Grandi, 2005).

Among the intangible services, Science Parks and incubators offer a unique platform for business and social exchanges. Through peer communications as well as exposure to other businesses in the park, knowledge is acquired in both the tacit and codified forms (OECD, 1997). Tacit knowledge emanates from informal exchanges while the codified form is the formal exchange. As a result, new ventures and business associations can be created alongside improvement in the current venture. This acquisition of "*social capital*" and knowledge are dealt with in more detail in a later section.

Other services offered by Science Parks and incubators depend on their missions and structure. Grimadi & Grandi (2005) describe how some incubators linked to universities limit their "*origin of ideas*" to within the university whereas other incubators are more "*outward looking*" and accept new business ventures from the corporate sector. Finally, the incubation period allowed by the Science Park or incubator is often the determinant in defining the services to be offered (Grimadi & Grandi, 2005).

2.5 Social Capital, Teamwork & Diaspora

Building up the social capital or networking among tenants in a Science Park is recognized to be an essential requirement for success. The work of Bollingtoft & Ulho (2005) illustrates the role and importance of social capital and trust-related aspects during entrepreneurial activities. Entrepreneurs are individuals who recognize and exploit opportunities and they need to operate in an environment of peers so that the social and business exchange can evolve (Shane & Venkataram, 2000, as cited by Bollingtoft & Ulhoi, 2005). Thus the opportunity to acquire social capital forms part of the intangible resources which a Science Park or incubator offers. As Bollingtoft & Ulhoi (2005) put it "*the incubator offers the possibility to obtain legitimacy, social inputs and psychological support*".

In a similar vein, there is increasing interest in entrepreneurial teams (Phan et al., 2005). It is regarded that team members help to contribute to the multi-disciplinary nature of new ventures which may not be available in a single individual. However, it is also recognized by the same author that team members can also lead to conflict and "*administrative inefficiency*". Thus an approach is to bring in team members who

contribute to the human capital and to discard others when their contributions cease to be relevant.

A final note on the "*human dimension*" of Science Parks is the contribution from the Diasporas. Many countries facing shortages or lack of human capital in terms of technological and business knowhow are attracting their Diasporas with a view to "*populating*" and "*re-energizing*" their Science Parks. China and Korea are actively attracting their nationals working in Science Parks in the US to come and settle back in their country of origin by offering attractive packages and research infrastructure (Koh et al., 2005).

2.6 Governance, Financing & Organizational model

The extant literature does not cover in detail the governance of Science Parks. Phan et al. (2005) considers that there is a dearth of studies that address issues concerning governance of Science Parks. However, most Science Parks can be classified as being Government initiatives, University initiatives, Private sector initiatives or a combination of these three stakeholders. Grimaldi & Grandi (2005) describe 4 models of incubators/science parks, ranging from public bodies which are non-profit to profit-making organizations set up by private enterprises. Non-profit oriented Science Parks and incubators are set up with a view to promoting economic development. They sometimes charge 'modest' fees for their services and are funded from the local governments. This type of organization has been the subject of criticism with regard to their effectiveness (Sherman, 1999, cited by Grimaldi & Grandi, 2005).

There has also been a surge in the number of private incubators which are profit-driven. Chinsonboon (2000) studied a number of private incubators in the US and concluded that their purpose was to "*quickly create new ventures in return for a portion of equity in the new venture*". They also provide pre-seed, seed and other early investments by Business Angels. These investors not only provide the necessary early investment but also assist in the management of the new venture as well as providing access to their business networks. The objective is to shorten the "*time to market*" or increase the "*speed to market*" so that they can maximize the returns on their investments.

More recently, Bollingtoft & Ulhoi (2005) described a novel form of governance which is emerging in the management of incubators in Denmark. This form is based on strong networking among the tenants who themselves assist in administering the incubator. Thus, the "*networked incubator is driven by a bottom-up approach, where the new ventures themselves have developed and managed the incubator* " .

Form the above, it therefore appears that there is no single formula for the governance, financing and management of Science Parks or incubators. The appropriate model will depend on the mission and purpose as well as the services to be provided by the Park or incubator. This conclusion strongly supports the school of thoughts that Science parks cannot be merely transposed from region to region or country to country. Many Asian countries such as China, Korea, Singapore and Malaysia have realized that the local context in which the Science Park is to be located, is an important element in the design of the Park (Koh et al., 2005)

2.7 Performance of Science Parks

Given the significant growth in numbers of Science Parks around the globe, one may be led to believe that Science Parks are delivering their promises of producing technological innovations that can be commercialized and thereby creating wealth and jobs. However, the literature contains plethora of studies (Amirahmadi & Saff ,1993, Quintas et al., 1992, Siegel et al., 2003, Felsentein, 1994) which question the functioning and performances of Science Parks. One of the identified difficulties is the appropriate criteria and methodology to be employed to measure the performance of Science Parks.

Many studies have focused on comparing the performances of firms located within the parks to those located outside. Although the results are not conclusive, there is no strong evidence that all Science Parks offer a competitive advantage to their tenants. The work of Lofsten & Lindelof (2003) showed that firms located in Science Parks in Sweden have much wider market distributions compared to those which are not. Likewise, in Italy, Colombo & Delmastro (2002) showed that on-park firms had higher growth rates. In Taiwan, Yang et al., (2009) also showed that on-park firms outperformed off-park ones. However, in Israel, Felsentein (1994) is of the view that "*the attraction of Science Parks is due to perceived status and prestige rather than benefits in terms of technology and information flow*". Along the same line, Bakouros et al., (2002) could not identify clear benefits for firms linked to the local universities in Greece, while in the UK, Westhead (1997) reported statistically insignificant differences in the performances on on-park and off-park firms.

The difficulty in comparing performances of Science Parks is compounded by the fact that models of Science Parks as described above, vary regionally from within

countries as well as from country to country. Some of the variances in the structure and governance of the Science Parks are significant, which make comparisons even harder. For example, some parks are entirely funded by government and are controlled by the state while others generate their own funding and have strong independent linkages with universities and the business sector, in particular with multi-national big player companies. Furthermore, due to the regional mandate of some Science Parks, success is sometimes measured against some form of "*externality*" such as increased employment in the region or increased exports out of the region (Amirahmadi & Saff, 1993).

A further complication which makes across country comparisons hard is the cultural differences and the contrasts in "*behavioral habits*", particularly in the Asian countries. Yang et al.(2009), take the cultural differences further and also examine the performance of firms located in the Science Park relative to those located outside the park. In this respect, it is shown that Science Parks located in Taiwan show different trends to those in Europe. In the same vein, Tan (2006) reports on the cultural and social impacts on the development of Science Parks in China.

To sum up, and as argued by Phan et al., (2005), there does not seem to be any theoretical and systematic framework to understand the roles of Science Parks and incubators and this leads to a lack of clarity regarding the performance of Science Parks. Indeed, the current study aims at shedding some light by introducing a framework within which a Science Park could be assessed.

2.8 Literature Gaps and Contributions of the Present Study

Very few studies have used a theoretical model to analyze the potential impact of a Science Park on the economic competiveness and productivity of a region or country. It appears that the only study to that effect is that of Wonglimpiyarat (2006) which makes use of Porter's diamond model to examine the economic development of the Silicon Valley Science Park. However, even this study is limited to a description of economic activities around a Science Park and does not necessarily provide a framework within which a Science Park can be assessed. Thus the first contribution of the present study is:

(i) **Presentation of a theoretical framework to assess the impact of a Science Park on the competitiveness of a region or country.**

While there are plethora of studies on Science Parks, most of these focus on developed countries in the USA, Europe and some of the advanced nations in Asia. There exists relatively little work on the structural forms and performance of Science Parks in developing countries and even less on those in small island states. Bakouros et al. (2002) studied 3 Science Parks in Greece as a "*developing peripheral European country*" and showed significant differences in operations when compared to Science Parks in developed countries of Europe.

In 2009, the Economic Commission for Africa produced a report whose main recommendations was that models of technology parks in African countries need not be similar but rather tailor made to the type of development in the individual African countries. An important question asked in the same report is "*Is it pertinent to create technology parks for all African countries?*". With regard to small developing island

states, some studies have been carried out for the Singapore Science Park although strictly speaking Singapore is most certainly not a developing country as it enjoys a GDP capita exceeding those of many advanced European countries. Similarly, Science Parks in Hong Kong would be classified as being in a developed country.

Therefore, it appears that very few, if not any study has been carried out on the type of Science Park that may fit into the context of a small island state. Therefore, a second contribution of the present work is:

(ii) Defining the roles and functions of a Science Park in a small island state.

Finally, most studies have focused on the post-evaluation of the Science Park after its creation and during its operation. There are extremely few studies which deal with the pre-setting of a Science Park. It is felt that the strategy and methodology adopted in this study could offer guidelines to other pre-feasibility studies on Science Parks. Thus, a fourth contribution of the present work is:

(iii) **Introducing a methodological approach to the undertaking of a pre-feasibility study for the setting up of a Science park.**

2.9 Conclusions

The literature on Science Parks is plentiful although there are some gaps due mainly to the absence of a theoretical or even empirical framework within which a Science Park can be evaluated and compared with others so that best practices can be formulated. This Chapter has highlighted some of the main issues concerning the conception, operation, performance and the social dimension of Science Parks and incubators. In particular, the varying missions and wide range of services offered by

Science Parks lead to the conclusion that each Science Park has its own "*reason for existence*" and its own "*clientele*". Therefore, models of Science Parks cannot be transposed from one region to another. To that effect, pre-feasibility studies to contextualize the Science Park become important. This is the main contribution of the present study and the next chapter introduces the methodology to be used.

Chapter 3: Research Methodology

3.0 The Research strategy

The strategy adopted to systematically derive the roles and functions of the Science Park is based on a top-down and bottom-up approach. The top-down procedure involves the use of information obtained from secondary data analysis of the literature to identify best practices in Science Parks and to test these in the context of Mauritius. The bottom-up process seeks the views of the main stakeholders through qualitative in-depth interviews and quantitative surveys. This strategy is schematically shown in figure 3.0. There are four important components, namely; use of the Porter's competiveness model, use of secondary data analysis, undertaking of a qualitative survey based on in-depth interviews of key decision makers and finally carrying out a quantitative survey of enterprises. The various inputs and outputs of each component are as shown in Figure 3.0. An implicit objective in this approach is to validate the data through triangulation from the qualitative and quantitative analysis. The next sections describe each of the major components of the research strategy although specific details of the methodologies employed are covered in the respective chapters.

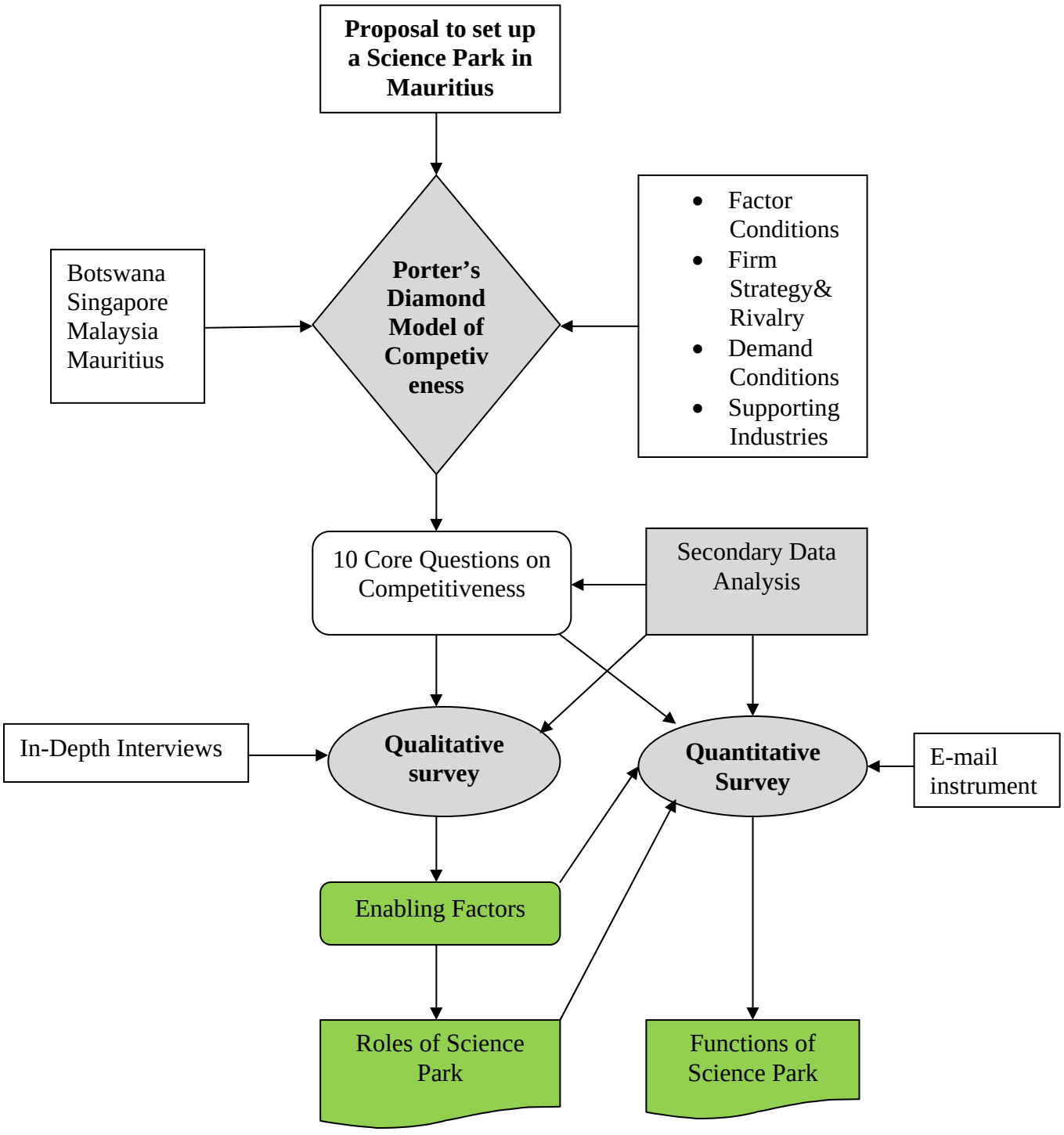

Figure 3.0 Research Strategy to formulate the roles and functions of a Science Park in Mauritius

3.1 A theoretical Framework of Competitiveness

The proposal to set up a Science Park principally aims at enhancing the competitiveness of the Mauritius. To that effect, first, the Porter's diamond model for competitiveness is used to assess the competitive advantage of the island relative to similar developing countries, such as Botswana, Singapore and Malaysia. In particular, the impact of the Science Park on the four determinants of the Porter's model, namely, the factor conditions, context for firm strategy and rivalry, demand conditions and related and supporting industries, are examined. This approach is similar to that used by Wonglimpiyarat's (2006) in simulating the characteristics of the Silicon Valley Science Park although in the present work the methodology is extended to cater for country comparison. The objective is to identify some of the strengths as well as the constraints that Mauritius faces with regard to technological developments. Data published in the recent Global Competitiveness Report (2009) are used to compare the competiveness of the four countries. In this way, the impact of a Science Park on the competiveness of Mauritius was assessed. In the application of Porter's diamond model as described in Chapter 4, this assessment lead to 10 core questions pertaining to the potential roles of the Science Park in Mauritius. These questions were then used as a basis for the design of a qualitative survey as described later.

3.2 Secondary Data Analysis

Most of the findings of the literature survey on which the secondary data analysis is based upon have already been presented in the previous chapter. As described by Phan et al., (2005), "*science parks are distinct organizations within the technological entrepreneurial value chain*" and that value chain itself "*comprises the set of organizations whose activities are linked by successive transformation of resources*

and knowledge inputs to marketable outputs". Thus, in order to comprehend and evaluate the role of the Science Park, it has to be situated within the entrepreneurial value chain. The methodologies used to study the various facets of Science Parks are mostly based on qualitative techniques and quantitative surveys or a combination of both. Westhead and Storey (1995) collected data through 284 face-to-face interviews to assess the views of tenants located on the park. The work of Gower et al., (1996) made use of a structured questionnaire to survey the management of 30 Science Parks. Westhead & Batsone (1998) surveyed 110 organizations located on British Science Parks to evaluate barriers to business start-up and growth. More recently, Siegel et al., (2003) used both qualitative and quantitative methods to identify critical organizational factors in university/industry technology transfer. By using a case study approach, Hansson et al., (2005), discusses "*alternating mediating roles for Science Parks in the science-industry relationship",* as applicable to Finland. In addition, there are several studies conducted in many countries which use both the qualitative and quantitative methods to compare the performances and sustainability of firms located on the Science Park to those located off the park (Braun & McHone, 1992, Colombo & Delmastro, 2002, Dettwiler et al., 2006, Siegel et al., 2003, Yang et al., 2005).

Analysis of the extant literature has shown that while there are extensive studies that have been performed, there is still the absence of a framework within which the performance of a Science Park can be measured. The main reason, as elaborated in the previous chapter, is the varying missions for which Science Park are created. In the present study, the findings with regard to the purposes of, services offered by, governance and structure and finally performance of Science Parks operating in

other countries, and as described in the previous chapter, are used to guide both the design of the surveys as well as the interpretation of the data collected.

3.3 Qualitative Survey – In-Depth Interviews

With a view to testing and assessing the acceptability of the Science Park in Mauritius, a qualitative survey of key decision makers and opinion leaders in the country was undertaken. The interview questionnaire was designed based on the 10 core questions which emanated from the Porter's model. In addition, further inputs from secondary data obtained from the literature survey, were used such that relevant information could be gathered with regard to the potential roles of a Science Park in Mauritius. The details of the qualitative survey are given in Chapter 5. Coding of the data as well as the use of network diagrams were used to establish the various relationships between the roles of the Science Park. In particular, the coding techniques of Basit (2003) and Thomas (2003) were extensively used in the qualitative data reduction process. A major finding of the in-depth interviews is that the creation of a Science Park in Mauritius necessitates the existence of a set of enabling factors. This requirement appears to be crucial for the Science Park to be performing and is elaborated in Chapter 5 which gives full details of qualitative survey methodology and its findings.

3.4 Quantitative survey – E-mail Questionnaire

The final step was to survey the business sector through a quantitative instrument in order to formulate the desired functions and services to be offered by the Science Park. Since the primary thrust of the Science Park would be to serve the business sector through technological innovation, a major quantitative survey covering enterprises in the manufacturing sector and the Information Communications

Technology (ICT) sector was undertaken. The sampling frame consisted of all enterprises in the manufacturing and in ICT sector which had an e-mail address. The survey instrument was designed using both inputs from the qualitative survey and finding from secondary data analysis. The survey was undertaken through self-administered questionnaires forwarded by e-mails to the enterprises. This approach required close monitoring in order to achieve a satisfactory response rate. The details of the quantitative survey methodology together with the statistical data processing and interpretation of the results are found in Chapter 6.

Chapter 4: Contextualizing the Setting up of a Science Park in Mauritius

4.0 Introduction

This chapter presents the proposal of setting up a Science Park in the island of Mauritius within a theoretical framework. This is necessary in order to systematically analyze the potential role of the Science Park on the economic landscape of the country. First, the competiveness of the Mauritian economy is compared internationally, focusing primarily on three other countries which bear similarities to the island of Mauritius. Using published data from the Global Competitiveness (CG) Report (2009), it is shown that the global competitiveness of many nations is strongly correlated with the nation's sound university-industry collaboration in R&D. Indeed, a Science Park can be viewed as a bridge between academia and industry (Amirahmadi & Saff, 1993). Second, the Porter's Diamond Model of competitiveness (Porter, 1998) is used to contextualize the setting up of a Science Park in Mauritius. Third, by examining the potential impacts on the variables making up the determinants of competitiveness, a set of ten core questions are derived with regard to the potential role of the Science Park in the economic environment of Mauritius. These questions will be the basis for the design of in-depth interviews to be used in a qualitative survey of key decision makers and to be described in the next chapter.

4.1 Global Competitiveness and Innovation

The overall aim of the science park is to enhance the global competitiveness of the island through the upgrading of its technological base and the creation of high-tech innovative small enterprises. In the present analysis, the competiveness of Mauritius is viewed relative to that of three similar nations, but which are at different stages of economic development. The countries selected for the comparison are Singapore, Malaysia and Botswana. In a recent ranking exercise involving 133 countries, the

Global Competitiveness Report of the *World Economic Forum* (WEF, 2009) ranked Mauritius and the three other countries as follows:

Country	Global Competitive Index (1-7)	Global Ranking
Singapore	5.55	3
Malaysia	4.87	24
Mauritius	4.22	57
Botswana	4.08	66

Table 4.0 Global Competitiveness Ranking (source: GCR, 2009)

In particular, the Global Competitiveness Index is based on 12 pillars (WEF, 2009) of which the last is 'Innovation'. In this context, the figure below compares the ranking (out of 133) of the four countries with regard to the innovation pillar.

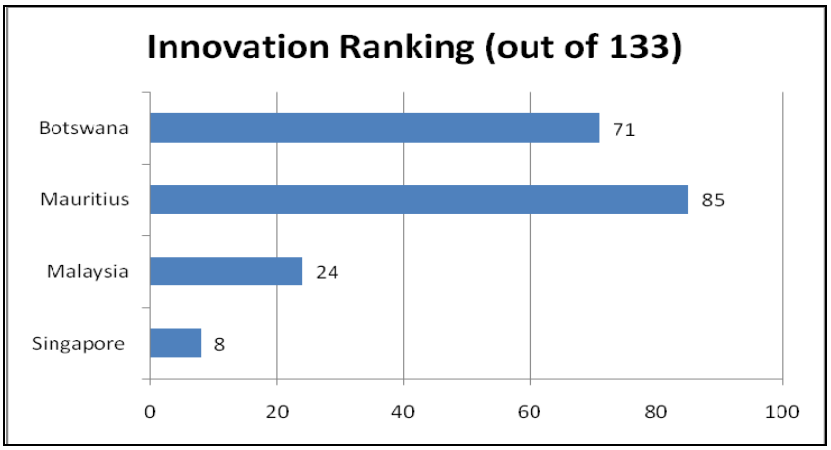

Fig. 4.0 Global Ranking for Innovation (Data from: GCR, 2009)

As can be seen, Mauritius, in spite of being ranked 57 on overall competitiveness, is in the bottom list as far as innovation is concerned. Thus, by improving its ability to innovate, the country can significantly enhance its global competitiveness.

The Global Competiveness Report also recommends that an environment conducive for innovation "*implies sufficient investment in Research & Development, the*

presence of high quality research institutions, extensive collaboration in research between universities and industry and the protection of intellectual property". In particular, data from the same report show that there exists a strong positive correlation between the Competitive Index of a country and the University-Industry collaboration in R&D in that country. The following chart illustrates this relationship for most of the 133 countries involved in the competitiveness ranking:

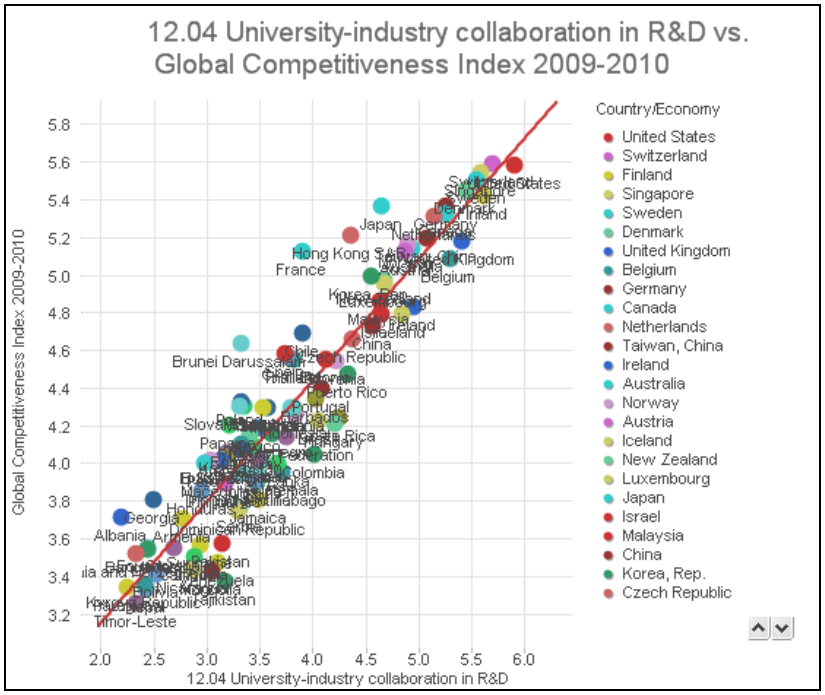

Figure: 4.1 Correlation between Competitiveness and University-Industry Collaboration (Source: GCR, 2009)

As can be seen, the stronger the collaboration between academia and industry, the more globally competitive is the economy. Countries which top the ranking, such as Switzerland, USA, and Singapore all have very strong linkages between their universities and industries.

Within the context of the selected countries to be compared with Mauritius, the figure below shows the level of university-industry collaboration:

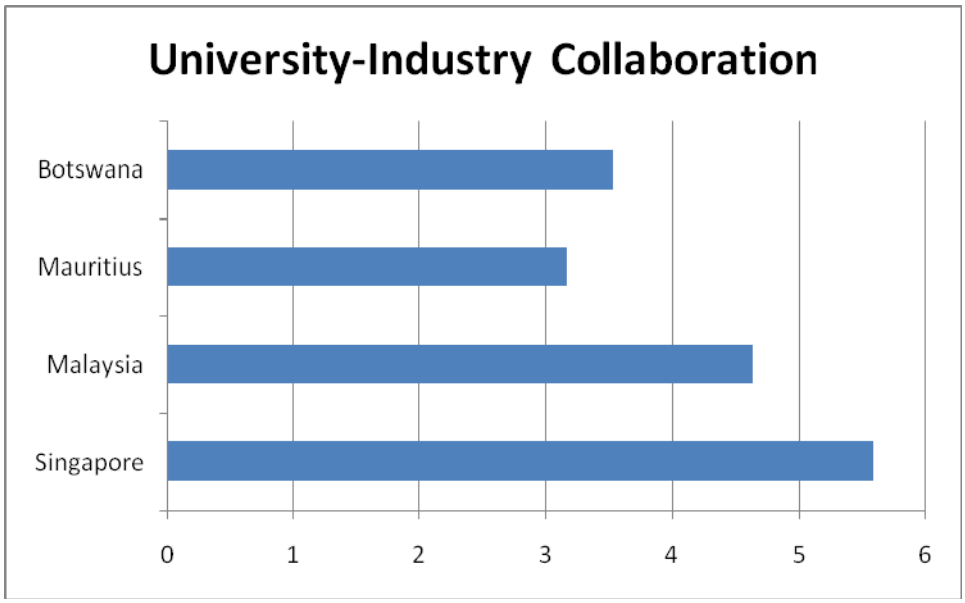

Figure 4.2 Index for University-Industry collaboration (0=poor; 7=excellent) (Data from: GCR, 2009)

As noted, Mauritius has the least score, indicating that there is much improvement to be made in its University-Industry collaboration. The setting up of the Science Park indeed aims at improving this relationship.

While Mauritius and Botswana are leading countries on the African continent, being respectively ranked by the Global Competitiveness Report as 2nd and 3rd among the African countries, they are obviously not at the same stage of development as Malaysia and particularly as Singapore. Indeed both Singapore and Malaysia have invested in Science Parks as early as in the 1990's (Koh et al., 2005, Ramasamy et al., 2004) whereas Mauritius and Botswana currently do not have Science Parks. The same authors, respectively, report on how Singapore is extending its Science Park into a massive 'North One' Science Park, while Malaysia is in the process of creating an equally massive Science Park known as the 'Multimedia Super Corridor' by merging existing parks and creating new institutions with the objective of enhancing their technological bases. The next section describes a theoretical model within which the setting up of a Science Park can be analyzed.

4.2 A Theoretical Framework for Comparative Analysis – Porter's Diamond Model

With a view to further understanding and assessing the impact of the Science Park on the economy of Mauritius, Porter's Competitive Diamond Model (Porter, 1998) is made use of. This model is founded on four broad attributes or determinants of a nation which shape the environment in which local firms compete that promote or impede the creation of competitive advantage (Porter, 1998, p. 71). This model has been used by Wonglimpiyarat (2006) as a basis to examine the activities of the US Silicon Valley Science Park and to discuss how Silicon Valley has become crucial for the development of the high-tech industry in the US. The followings are descriptions of the four determinants of Porter's model and their applications to the four selected countries based on data published in the Global Competiveness Report:

4.2.1 Determinant One - Factor Conditions

Factor conditions comprise of the nation's position in factors of production, such as human resources, physical resources, knowledge resources, capital resources and infrastructure which are required to compete in a given industry. Factor conditions can be considered as basic factors such as labour, land and natural resources. Factor conditions also include advanced factors and specialized factors. In the subsequent analysis, first, some of the basic factors are compared for the four countries. Then advanced and specialized factors which are pertinent to innovation are discussed.

4.2.1.1 Basic factors

According to Porter (1998), these include factors such as road and building infrastructure, the educational system, the health system, the communication

system as well as the human resources. The charts below compare the scores (0-7, zero being minimum) as given by the Global Competitiveness Report (2009) for some variables of these factors in the four countries. A discussion then follows in order to situate these four countries in their different stages of economic development.

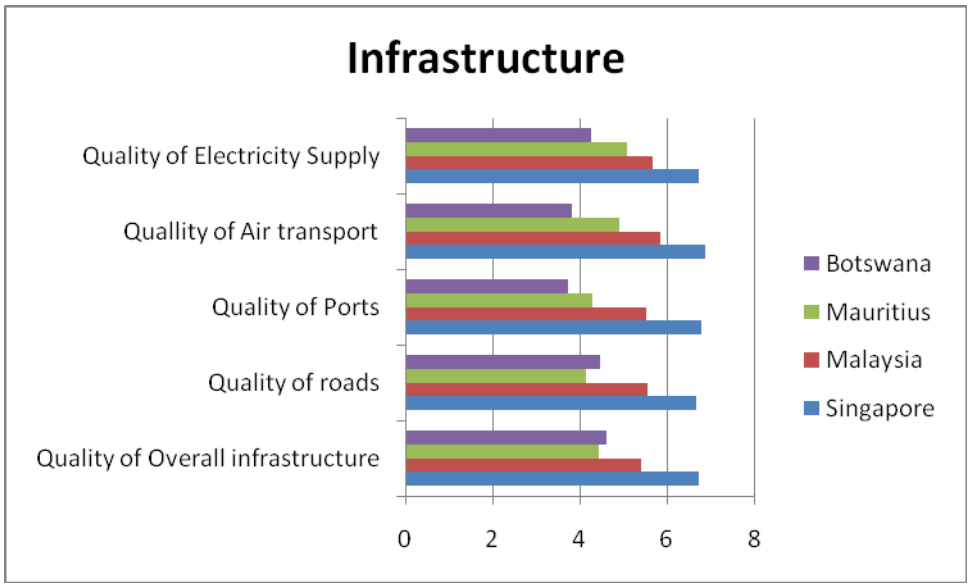

Fig. 4.3 Basic Factor – Scores for Infrastructure (Data from GCR, 2009)

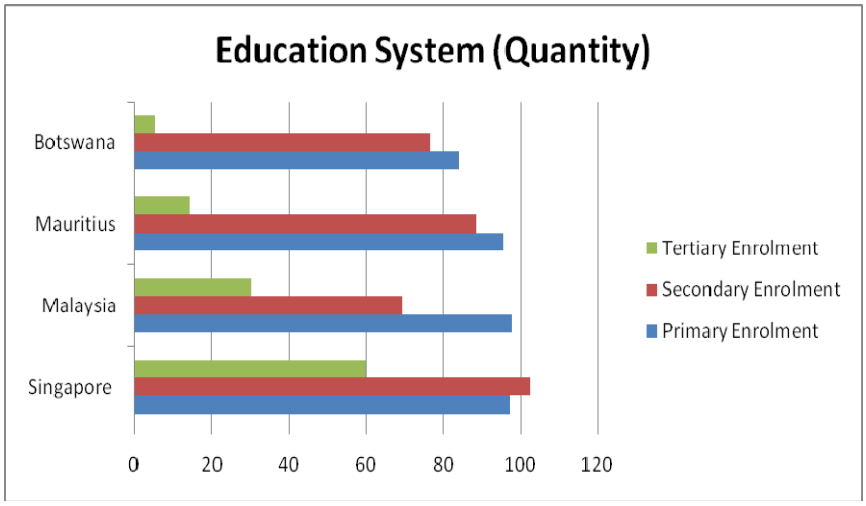

Fig. 4.4 Basic Factor – Education (% Enrolment) (Data from GCR, 2009)

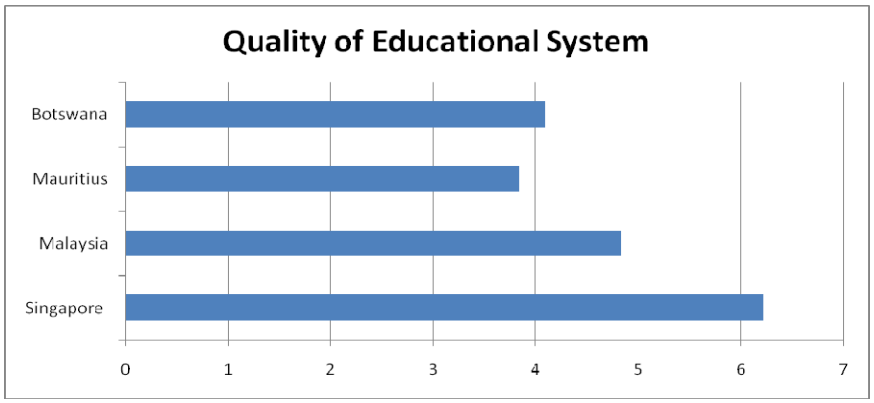

Fig. 4.5 Basic Factor – Scores for Education Quality (Data from GCR, 2009)

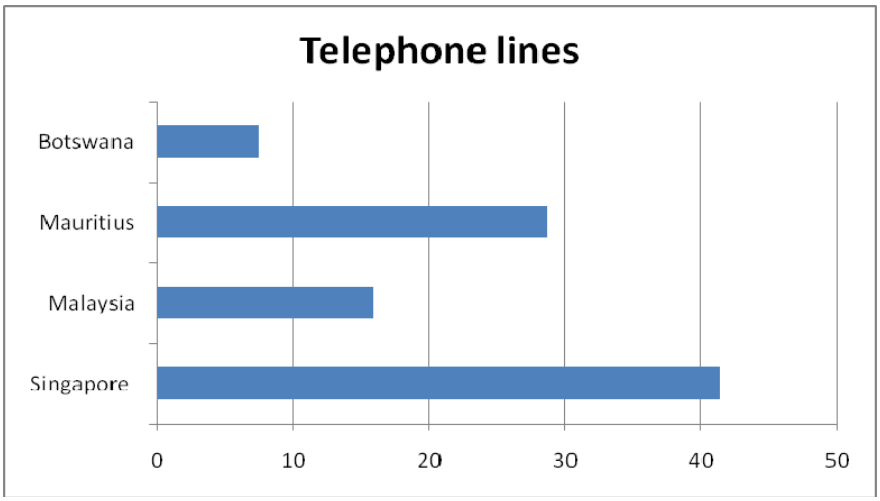

Fig. 4.6 Basic Factor – Scores for Communications (Data from GCR, 2009)

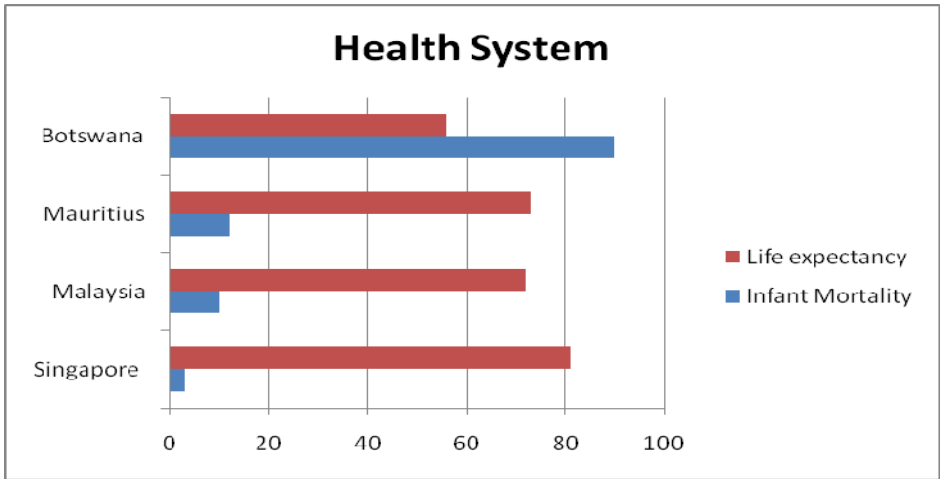

Fig. 4.7 Basic Factor – Indicators for Health (Data from GCR, 2009)

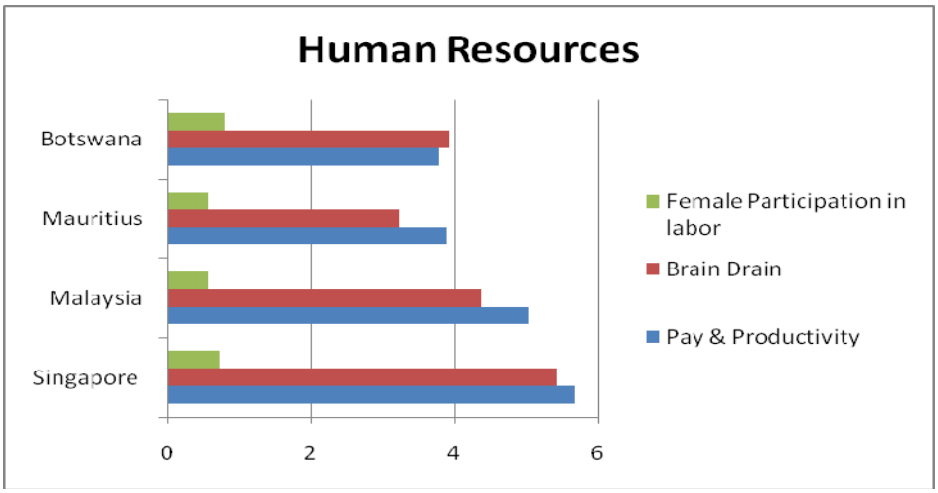

Fig. 4.8 Basic Factor – Scores for Human Resources (Data from GCR, 2009)

The above basic factor comparison consolidates the notion that the four countries under consideration are at different stages of development. With regards to infrastructure, clearly Singapore leads the group and Mauritius has the overall least score for infrastructure (fig. 4.3). The quantity and quality of the education system (figs. 4.4 and 4.5) in Mauritius need to be improved. Although at primary and secondary levels, the enrolment is good, the situation at tertiary level requires serious consideration as only about 13% of those aged between 18 and 24 years attend the local universities. However, this figure needs careful interpretation as many Mauritian students attend overseas universities. A more realistic figure would be about 24% (TEC, 2000), which is still inferior. The communication sector in Mauritius is well developed although lagging when compared to Singapore (fig. 4.6). As far as the health sector is concerned (fig. 4.7), Mauritius figures very well with low infant mortality rate and long life expectancy. In this sector, the real issue is with Botswana where HIV Aids is a serious obstacle to economic development. Econsult (2007) estimated that the impact of HIV Aids on Botswana could result in its economy be smaller by as much as 35% in the next 10 years compared to what it would

have been otherwise. Finally, the human resources comparison given in figure 4.8 shows that Singapore's workforce is more productive and there is more women participation as well as less brain drain compared to the other countries. In Mauritius, brain has been a great concern with many of those trained in overseas universities not wishing to come back to the island. As a result, there exists a fairly significant Mauritian Diaspora with highly qualified scientists and engineers (MRC, 2000).

Given the differences in basic factors, the four countries are therefore experiencing different stages of economic development. Indeed, the Global Competitiveness Report (2009) categorizes these countries as follows:

Country	***Stage of Development***
Singapore	Innovation-Driven
Malaysia	Efficiency-Driven
Mauritius	Efficiency-Driven
Botswana	Transition between factor-driven and Efficiency-driven

Table 4.1 Economic categorization (Source: GCR, 2009)

In the above table, the innovation-driven stage is the most advanced preceded by efficiency-driven and lastly factor-driven. The GC report argues that countries move from one stage to another stage of increased development through a transitional process whereby certain advanced and specialized factors have to be created, upgraded or improved. The next section describes some of these advanced and specialized factors necessary to transit to the innovative-driven economy.

4.2.1.2. **Advanced and Specialized Factors**

Porter (1998) describes advanced factors as being built upon basic factors and involve, for example high-skilled human resources. Specialized factors, on the other hand, involve infrastructure with specific properties and narrowly skilled personnel. A Science Park in the context of Mauritius can be considered as specialized factor. The charts below compare the scores of a few relevant advanced and specialized factor conditions in the four selected countries and which are pertinent to the technology development sector.

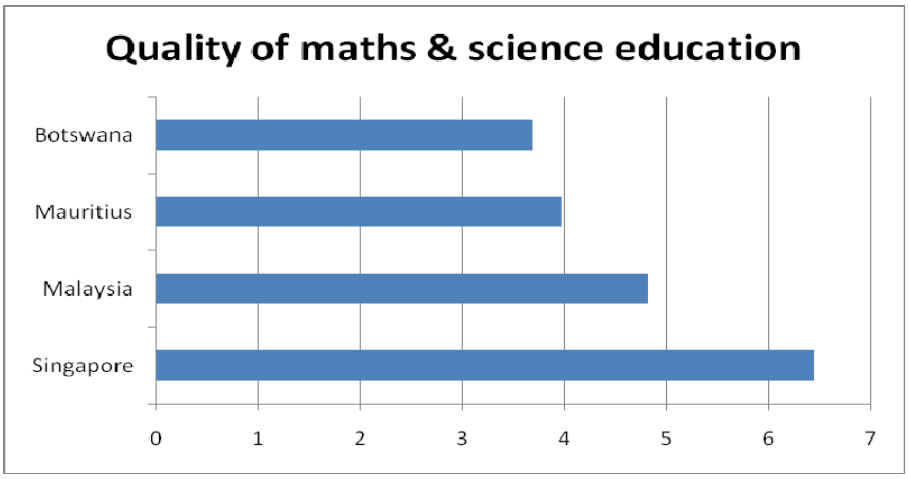

Figure 4.9 Factor Conditions – Scores for quality of science education (Data: GCR, 2009)

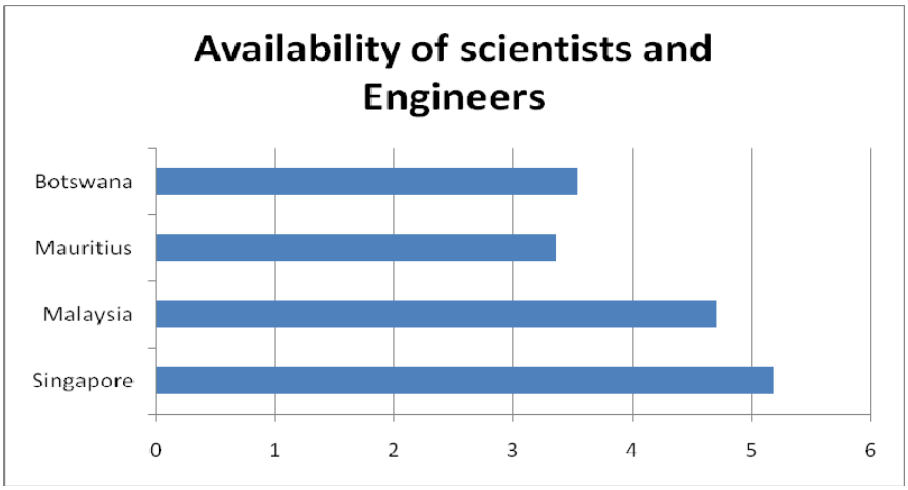

Figure 4.10 Comparison of scores for Advanced Factors (Data: GCR, 2009)

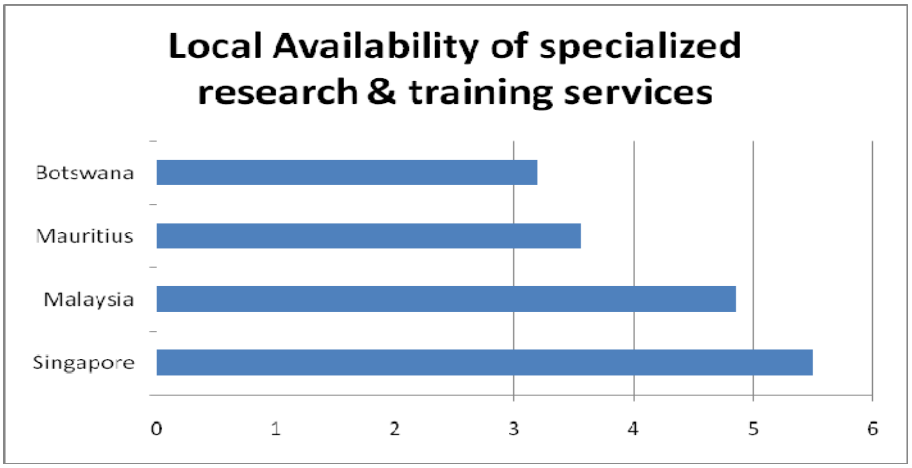

Figure 4.11 Availability of Specialized Factors (Data: GCR, 2009)

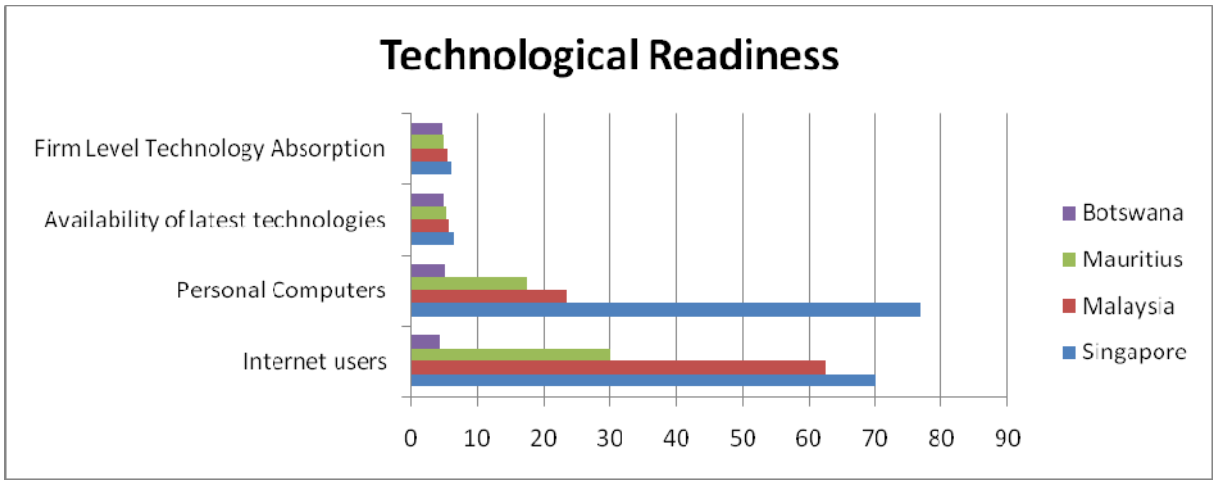

Figure 4.12 Comparison of Indicators for Technological Readiness (Data: GCR, 2009)

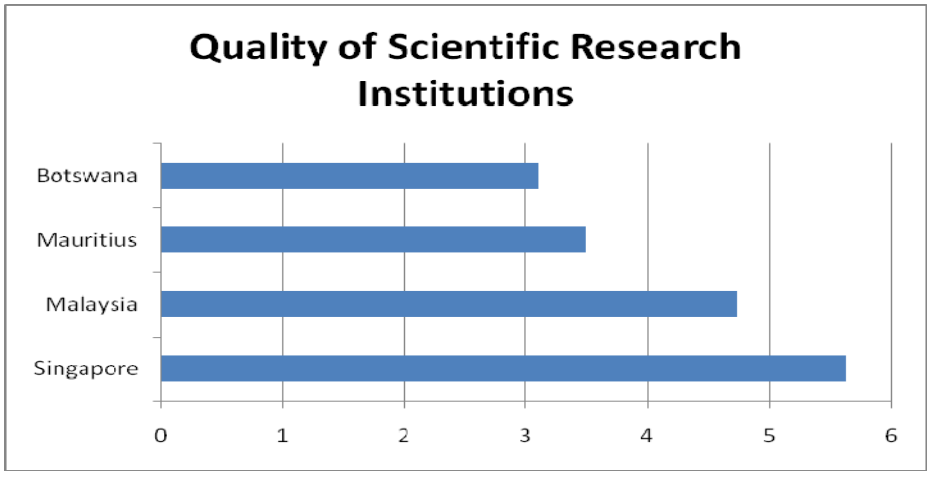

Figure 4.13 Comparison of scores for Specialized Factors (Data: GCR, 2009)

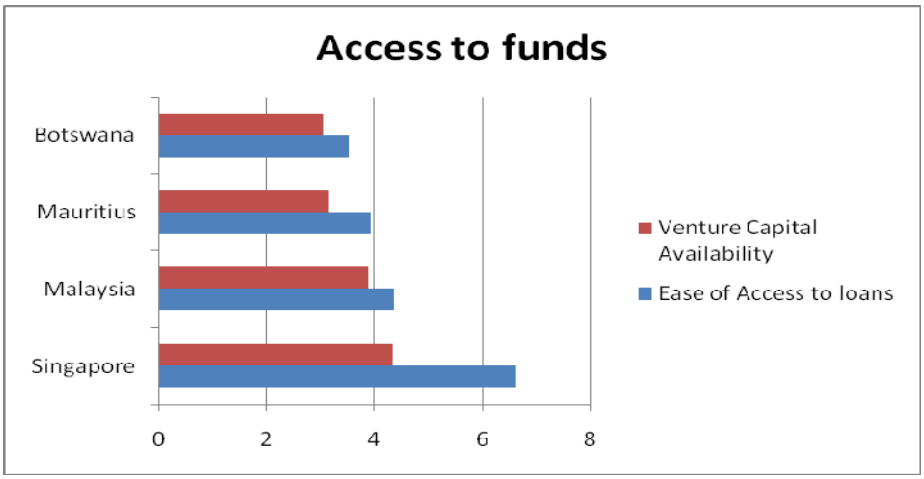

Figure 4.14 Scores for Access to Funds (Data: GCR, 2009)

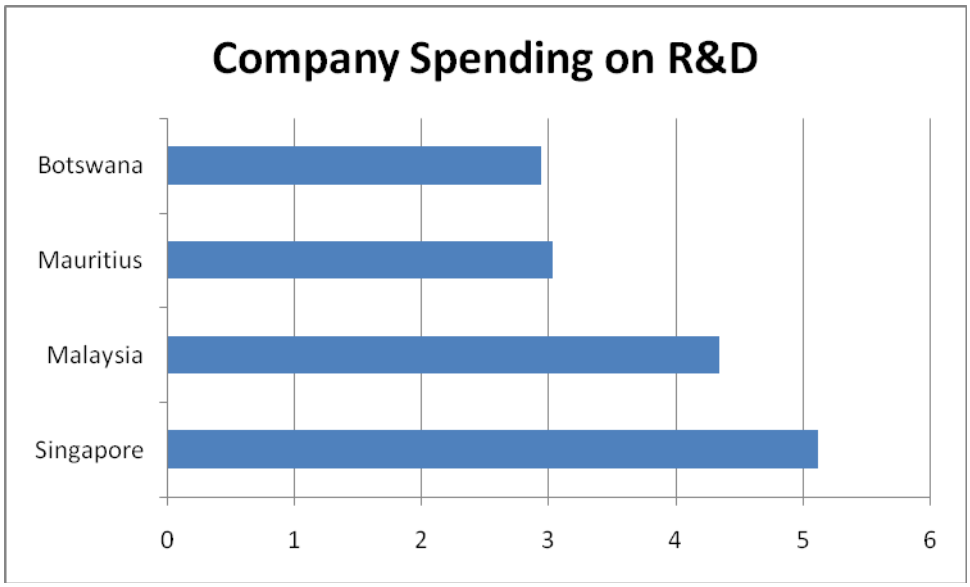

Figure 4.15 Scores for Company spending on R&D (Data: GCR, 2009)

4.2.2 Determinant Two - Firm Strategy, Structure and Rivalry

Porter (1998, p. 71) defines these as being the conditions in the nation governing how companies are created, organized, and managed, and the nature of domestic rivalry. They also deal with numerous 'soft issues' such as labour management, attitudes towards authority, interpersonal interactions, attitude of workers towards management, individualistic or group behaviour, professional standards and ethics. Language skills are also significant in influencing whether firms adopt a global outlook. The chart below compares

the variables of local rivalry and competition including the protection of intellectual property which is a key requirement in the promotion of innovation.

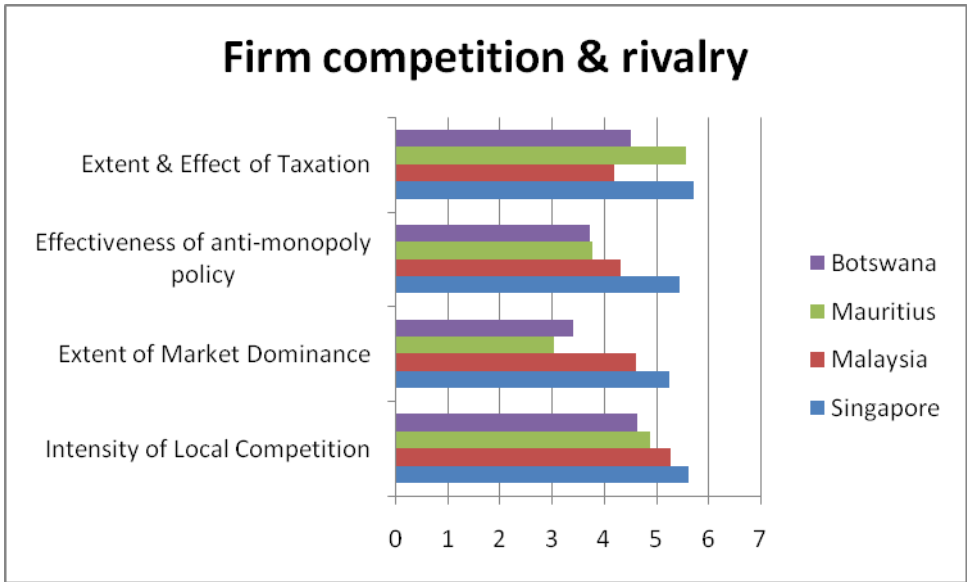

Figure 4.16 Scores for Firm Local Competition & Rivalry (Data: GCR, 2009)

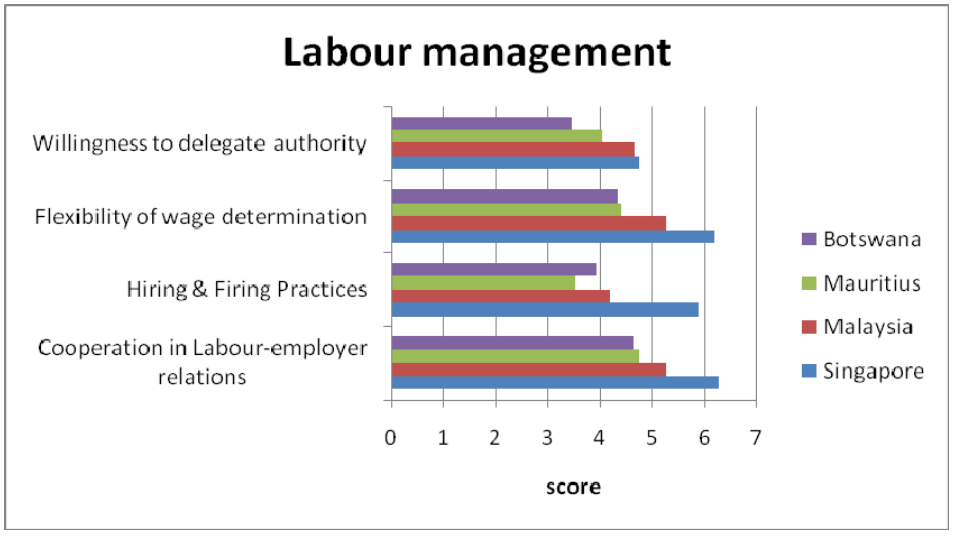

Figure 4.17 Scores for Firm Labour Management (Data: GCR, 2009)

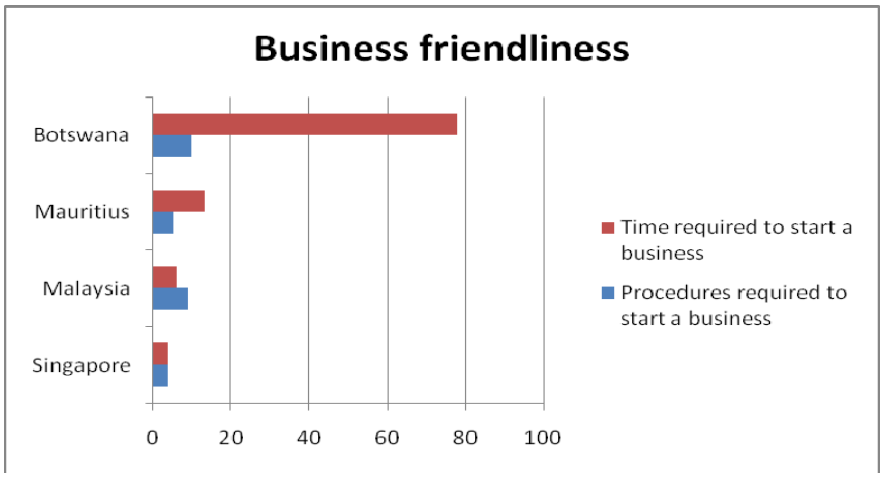

Figure 4.18 Indicators for Firm structure and rivalry (Data: GCR, 2009)

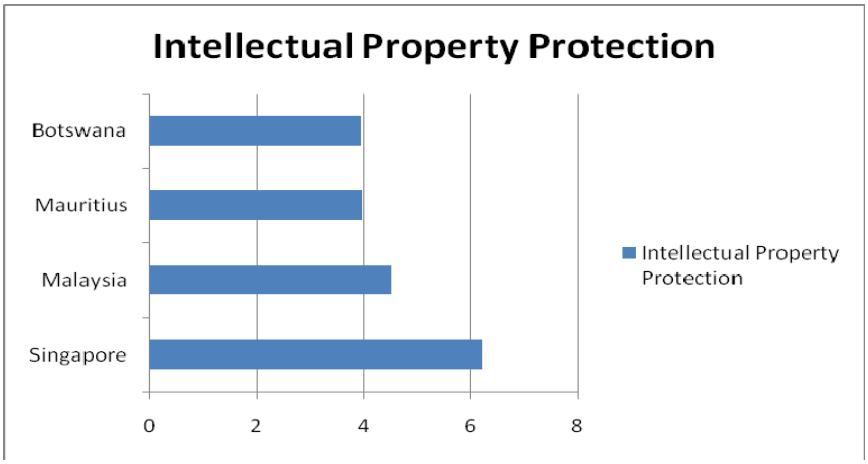

Figure 4.19 Scores for Firm rivalry (Data: GCR, 2009)

4.2.3 Determinant Three - Demand Conditions

These are described (Porter, 1998, p.71) as the nature of home demand for the industry's product or service. They include the size and sophistication of the home market as well as its growth rate and buyer's characteristics and need. Sophisticated markets also imply demanding buyers that can reach early saturation which will, in turn, spur creativity and innovation by the industry (Porter, 1998). The chart below compares the variables of demand conditions.

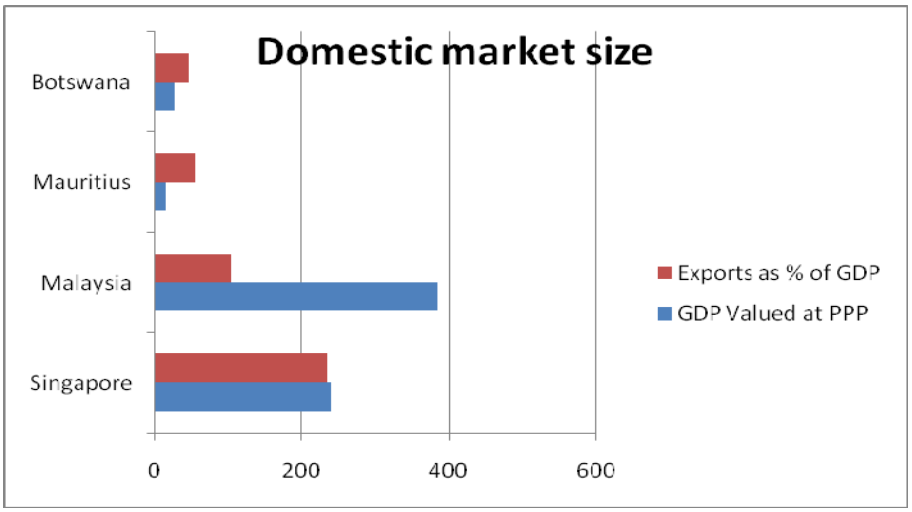

Figure 4.20 Comparison of Domestic Market Size (Data: GCR, 2009)

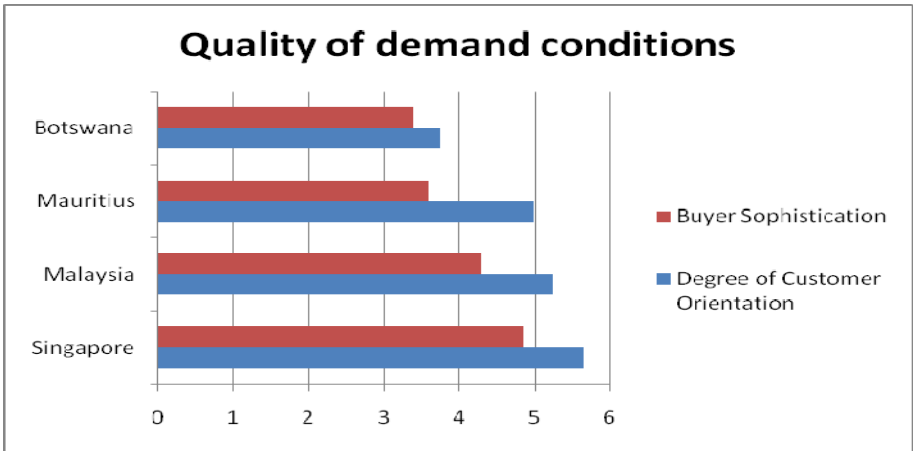

Figure 4.21 Scores for Quality of Demand Conditions (Data: GCR, 2009)

4.2.4 Determinant Four - Related and Supporting Industries

Porter (1998) describes these as the presence or absence in the nation of supplier industries and related industries that are internationally competitive. Suppliers play an important role in the process of innovation and technology upgrading. They help firms to be exposed to new methods and processes while acting as a conduit for transmitting information and innovation from firm

to firm (Porter, 1998). The chart below compares the supporting industries in the four selected countries.

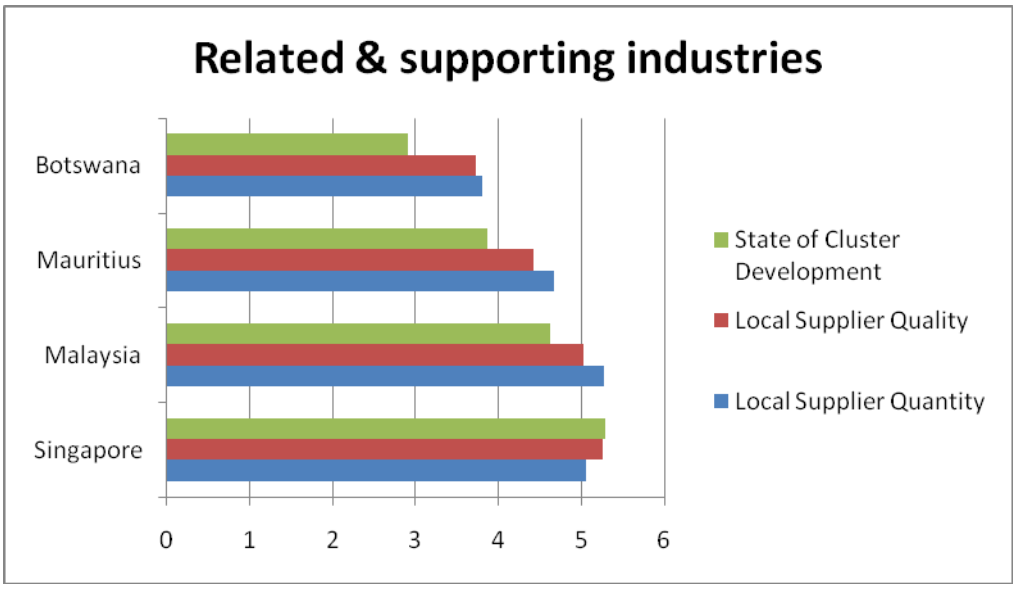

Figure 4.22 Scores for Related and Supporting Industries (Data CGR, 2009)

4.3 Summary of findings from Porter's diamond model

In this section, the different variables that make up the four determinants in the model of Porter, as presented above, are combined in order to quantify the respective determinants and thus allowing a comparison of the overall competitiveness of the four countries. In particular, the indicators shown above are given scores, so that the scale is 0 – 7, with 0 being the lowest. In addition, averaging is carried out over all variables that constitute a particular determinant in order to allow comparison. In this manner, the four determinants of Porter's diamond model are reconstituted as shown in the following charts for each of the countries:

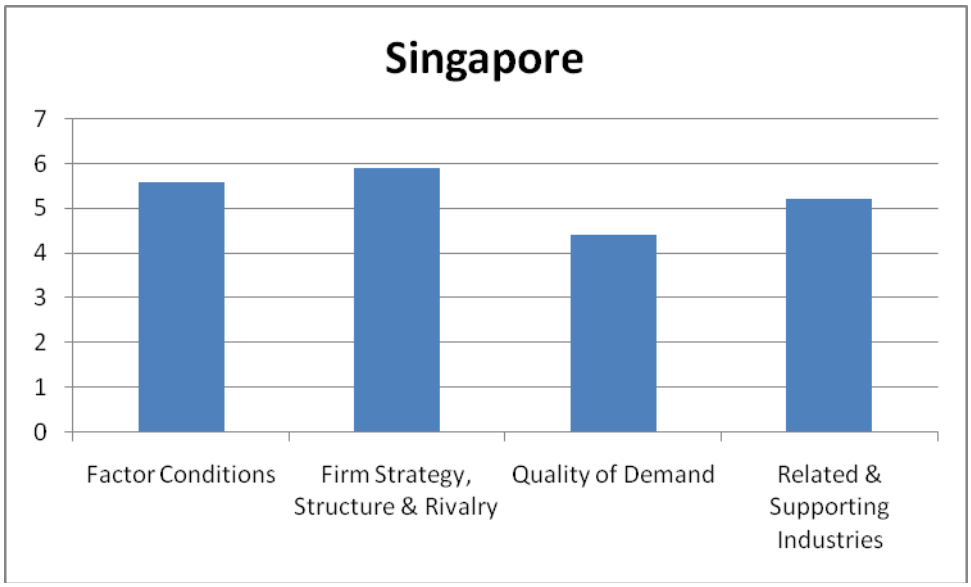

Figure 4.23 Porter's determinants for Singapore

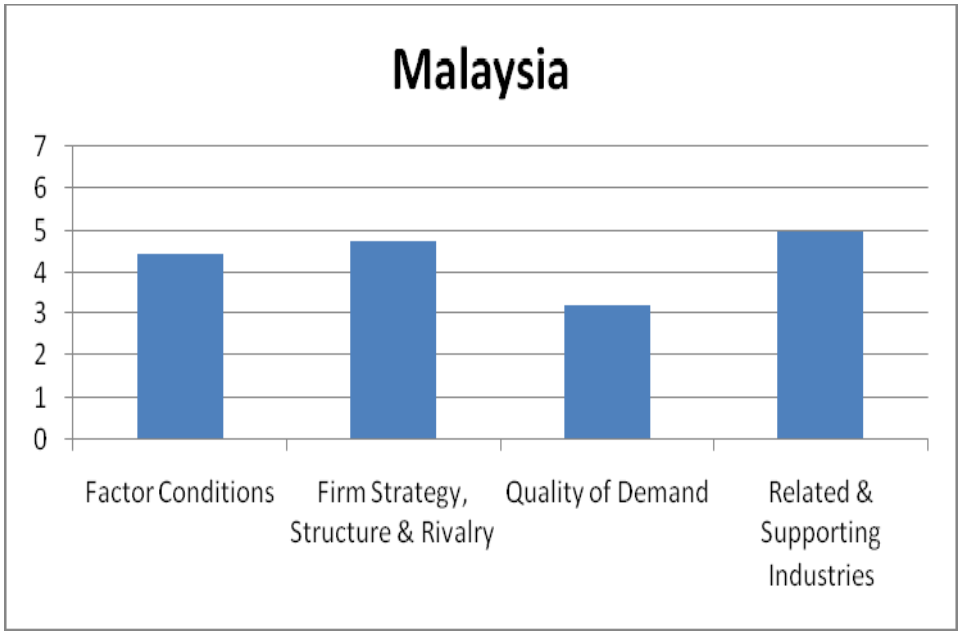

Figure 4.24 Porter's determinants for Malaysia

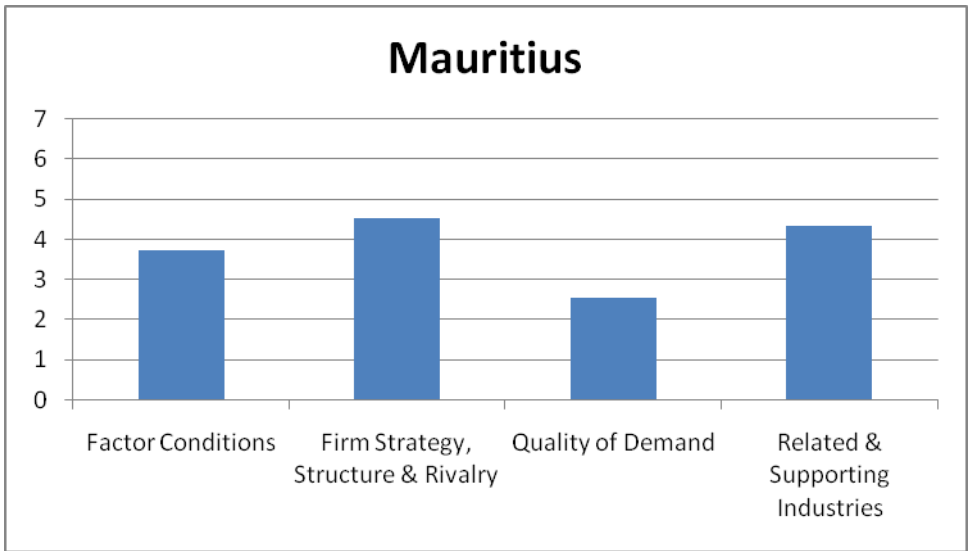

Figure 4.25 Porter's determinants for Mauritius

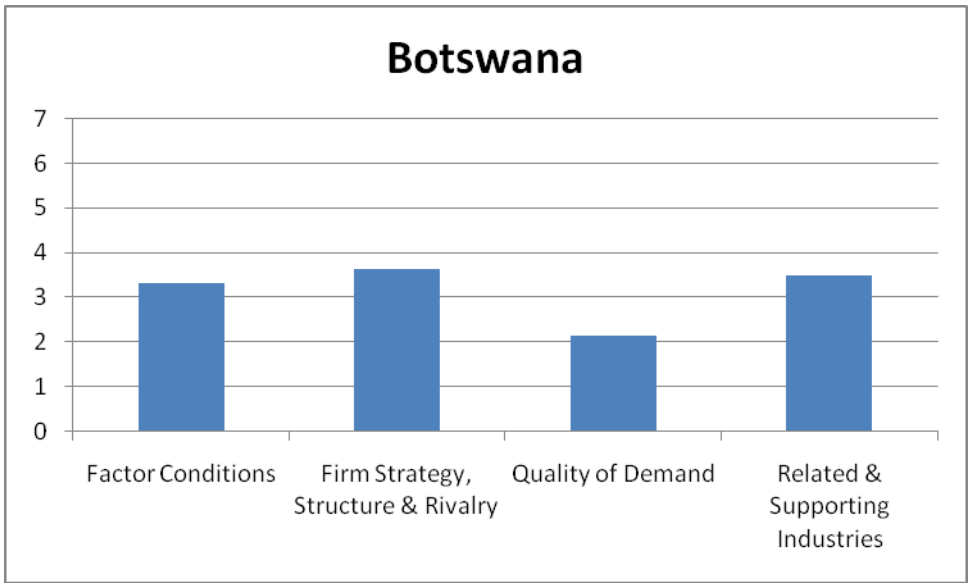

Figure 4.26 Porter's determinants for Botswana

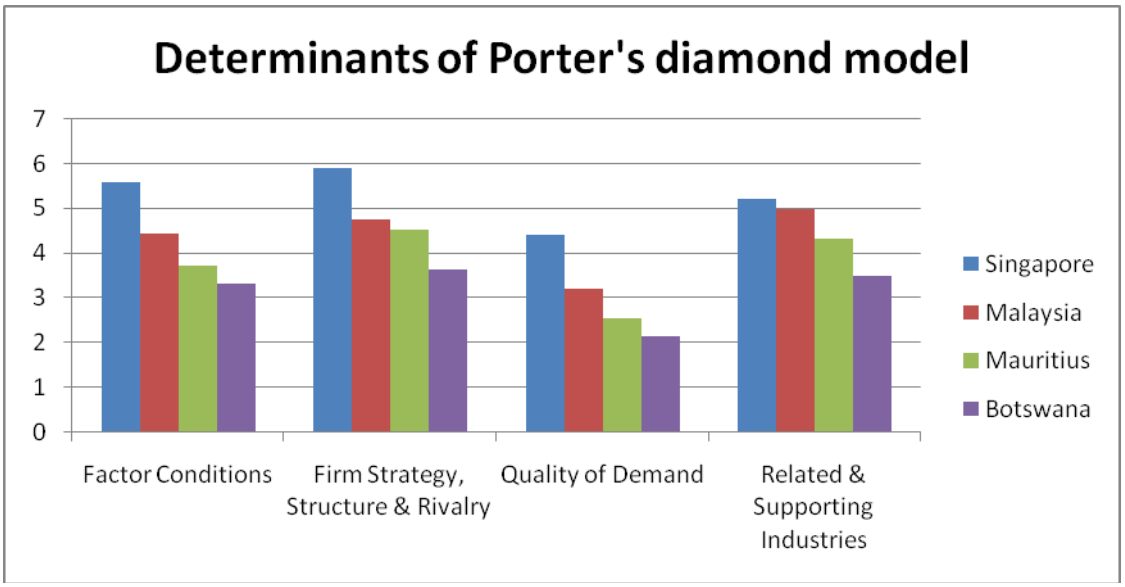

Figure 4.27 Country comparison of the determinants of Porter's diamond model

First, it is noted that for each of the four countries, the dominant determinant is that of 'Firm Strategy & Rivalry' and the weakest is 'Quality of Demand'. Singapore is the strongest in all four determinants among the countries. According to Porter (1998), all four determinants are in a state of continuous dynamism as each one is influenced by and influences each other. Since the setting up of a Science Park can be regarded as strengthening the Factor Condition, the present discussion focus on the influence of the other determinants on the Factor Conditions.

Porter (1998, p. 134) is of the view that "*Factor creation is perhaps most strongly affected by domestic rivalry*". This statement seems to be supported by the above findings which show that for every country, the 'Firm Rivalry' determinant is stronger that 'Factor Condition', which can be interpreted as 'Firm Rivalry' acting as a driving force over 'Factor Condition'. As elaborated by Porter (1998), competition among local firms often leads to factor creation, such as enhanced relationship with research institutions. In the case of Singapore which has the strongest 'Firm Rivalry', its 'Factor Condition' is also the strongest among the four countries. This could be partly accounted for by the strong collaboration between university and industries that

currently exists in Singapore and as shown earlier in fig. 4.2. The ‘Factor Conditions’ in Mauritius is weaker than those of Singapore and Malaysia but stronger than that of Botswana (fig.4.27). The same trend is observed for the ‘Firm Rivalry’ determinant. Given that ‘Firm Rivalry’ strongly affects factor creation, it can be hypothesized that the setting up of a Science Park in Mauritius could increase ‘Firm Rivalry’ which will in turn lead to an increase in ‘Factor Condition’.

Singapore also has the strongest ‘Quality of Demand’ which is a function of the size of the domestic market as well as the buyers’ sophistication (figs. 4.20, 4.21). This is explained by the fact that Singapore is a highly prized tourist destination which attracts over 10 million visitors a year (STB, 2008) from all over the world including many from neighbouring Asian countries. In addition, the sophistication of the local market is much higher than that of the other countries (fig. 4.21) and this could be attributed partly to the high quantity (fig. 4.4) and high quality (fig. 4.5) of its education system. Thus, the Singaporean ‘Quality of Demand determinant’ consists of rich, well-educated sophisticated buyers which, in turn, increase rivalry among firms and this leads to more factor creation. Mauritius has the smallest ‘Quality of Demand’ as its local market is indeed the smallest (fig.4.20). This situation forces the island to focus on the export market, particularly to the regional economic block of SADC which comprises of 14 countries and a net population of about 240 billion. As firms in Mauritius compete to have access to this potentially lucrative market, ‘Firm Rivalry’ will increase, and as discussed above, this will in turn, lead to an increase in ‘Factor Condition’.

According to Porter (1998, p. 135), ‘*related and supporting industries stimulate their own mechanisms for creating and upgrading specialized factors’*. Only Singapore has

a ‘Related & supporting industries’ which is lower than ‘Factor Conditions’. In the other three countries, ‘Related & supporting industries’ is stronger than ‘Factor Conditions’. This would suggest that in these countries, ‘Factor Conditions’ should be enhanced so as to simulate the Singaporean’s model in which ‘Factor Conditions’ leads ‘Related and supporting industries’. Indeed, the setting up of a Science Park in Mauritius and generally improving the relationship between university and industry will enhance the ‘Factor Conditions’. In particular, a Science Park forms part of the ‘Advanced & specialized factors’ and as can be seen below, Mauritius lags behind both Malaysia and Singapore; a situation which the Science Park will aim to improve.

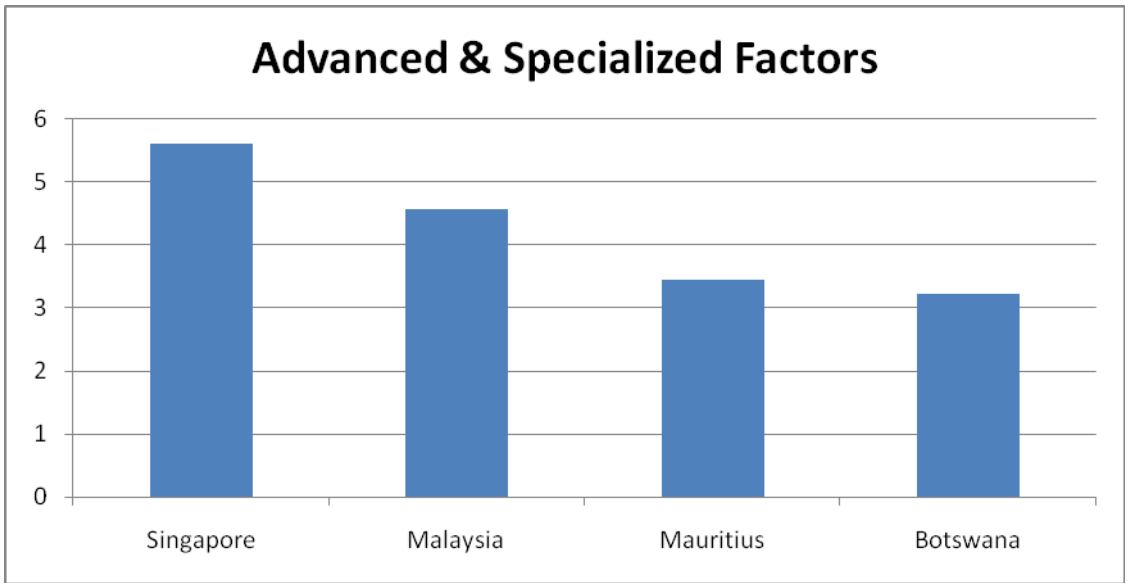

Figure 4.28 Country comparison of the Advanced and Specialized factors

4.4 Formulation of 10 core questions for qualitative survey

The above application of the theoretical framework of the Porter’s model reveals a number of sectors and measures which Mauritius has to address in order to improve its competitiveness and to make the transition from an efficiency-driven economy to that of innovation-driven. One of the sectors where Mauritius has to focus upon is the enhancement of its advanced factors and the creation of new specialized factors. It is

against this background that the proposal for the creation of a Science Park is being put forward. Appendix One describes in detail how the various variables which make up the determinants of the Porter's model are affected by the introduction of a Science Park. In particular, the analysis leads to the following set of 10 core questions pertaining to the potential roles of a Science Park in enhancing the competitiveness of the Mauritian economy.

Question One:

Qu_1: Will the setting up of a Science Park in Mauritius attract more students to undertake science and engineering subjects?

Question Two:

Qu_2: Will the setting up of a Science Park in Mauritius improve the technology absorption capacity of the country?

Question Three:

Qu_3: Will the setting up of a Science Park in Mauritius will improve the quality of the research institutions in the country?

Question Four:

Qu_4: Will the setting up of a Science Park in Mauritius will attract more venture capitalists as well as encourage companies to invest more in R&D?

Question Five:

Qu_5: Will local firms compete to be located inside the Science Park?

Question Six:

Qu_6: Will the setting up of a Science Park in Mauritius require that Intellectual Property generated from state funding be granted to the researcher/research institute undertaking the research?

Question Seven:

Qu_7: Will the setting up of a Science Park in Mauritius increase exportation to the SADC countries?

Question Eight:

Qu_8: Will the setting up of a Science Park in Mauritius create new products for the tourism industry?

Question Nine:

Qu_9: Will the setting up of a Science Park in Mauritius improve the quantity and quality of the suppliers?

Question Ten:

Qu_{10}: Will the setting up of a Science Park in Mauritius promote entrepreneurship and create new high-tech enterprises?

4.5 Conclusion

This chapter has postulated that a Science Park can improve the global competitiveness of Mauritius. This hypothesis is anchored on the need for Mauritius

to improve its capacity to innovate. Using the Porter's diamond model as a theoretical framework within which the Science Park is assessed, it is shown that the variables which constitute the four determinants of competitiveness, that is, factor conditions, firm strategy, structure and rivalry, demand conditions and lastly, related and supporting industries, for the island Mauritius are influenced by the setting up of the Science Park. By focussing on those variables of the determinants where Mauritius is lagging compared to Malaysia and Singapore; two countries where Science Parks have been in operation for a number of years, a set of 10 core questions were formulated. These questions essentially assess the potential impact and the role of a Science Park on the competitiveness and therefore the economic development of Mauritius. The next chapter uses a qualitative survey of key decision makers and professionals in Mauritius to seek answers to these questions through structured in-depth interviews.

Chapter 5: Qualitative Survey on the Roles of a Science Park

5.0 Introduction

This chapter presents a qualitative survey of key decision makers in the island of Mauritius to seek answers to the 10 core questions which were derived in the last chapter. These 10 questions, in essence, relate to the potential roles of the Science Park. In particular, using in-depth structured interviews of a sample of leading personalities, the questions are elaborated upon with a view to gauging the perceptions and attitudes towards the setting up of the Science Park. In this chapter, the objectives of the survey, the sampling design, the interview questionnaire design, the data collection, and the reliability of the research are described. The coding and categorizing techniques used for analysing the qualitative data are also given. Finally, the results of the qualitative survey are presented in a framework which depicts the various relationships among the roles to be played by the Science Park. These roles are to be used as a basis for a quantitative survey in the next chapter.

5.1 Objectives of Survey

The following are the main objectives of the qualitative survey:

(a) To seek answers to the 10 core questions which were formulated with regard to the potential role of a Science Park in Mauritius.

(b) To probe deeper into the proposal of setting up a Science Park in Mauritius with a view to exploring and identifying issues that may have been left out thus far or not covered in published secondary data.

(c) To gauge the attitudes and perceptions towards the setting up of the Science Park.

(d) To formulate the main roles for the Science Park in the context of Mauritius.

(e) To use the findings of the survey as guidelines to the design of a quantitative survey of small and medium enterprises with regard to the proposed functions and services of the Science Park.

5.2 Choice of Research Method

With a view to achieving the above objectives, a structured personal in-depth interview approach (White, 2000, p. 32) was chosen. The interview was structured because it was based on the set of prescribed questions derived in the previous chapter. These questions, in turn, required a quantitative response followed by detailed descriptive answers. This approach was preferred as it was considered the most suitable given the objectives of the survey as well as the constraint of time and availability of the interviewees. Furthermore, this approach allows open-ended questions to be set while also enabling the interviewer to probe deeper into some of the prescribed questions and beyond. In addition, given the smallness of the island and therefore the proximity of the people, the quality of the interviewee's attributes is known and as Clemmensen et al., (2004) describe, the quality of the output of the interview is highly dependent on the attributes of the interviewees. This was taken into account in the sampling design, as discussed next.

5.3 Sampling Design

The sampling methodology was based on the "*purposive sampling*", also called the "*judgemental sampling*" in which, according to White (2000, p. 63), the researcher picks the sample which will deliver the best information to satisfy the research objectives. To that end, the sample for the interview consisted of professionals from the three sectors of Academia, Government and the Private Sector. These three sectors constitute the main stakeholders that would be involved with the Science

Park. In particular, the Government and Private Sector professionals were Venture Capitalists and Business Managers. Altogether, there were 9 interviewees, broken down as follows:

Business Manager	**Venture Capitalist**	**Academia**
Manager 1	VC1	Prof 1
Manager 2	VC2	Prof 2
Manager 3	VC3	Prof 3

Table 5.0 Sample Interviewees

All nine interviewees are well respected professionals in their fields. In academia, 3 Senior Professors in the scientific/technological field were selected. The three venture capitalists included senior investment bank managers from the private sector as well as a manager from a government project funding agency. The Business managers were selected on their experiences in running small and medium enterprises although one of them also had experience running a multi-national company.

5.4 Interview Questionnaire Design (Appendix Two)

In order to structure the interview and to be consistent in all the interviews, a questionnaire was designed to serve as a guide. The interview questionnaire starts with a short description of the proposal to set up a Science Park in Mauritius together with the overall objective of the Park. Next, some basic information regarding the respondent is requested. The 10 questions derived in the previous chapter are then used as a basis for the prescribed questions to be used in the in-depth interviews. The full questionnaire is available in Appendix Two. In order to avoid a straight forward YES/NO answer to the questions, each question is phrased in a statement to

which the respondent is then asked to respond in an ordinal manner. For example, the first question: *"Will the setting up of a Science Park in Mauritius attract more students to undertake science and engineering subjects?"* is recast as the following: "The setting up of a Science Park in Mauritius will attract more students to undertake science and engineering subjects", to which the responded had to tick one of the boxes shown below.

1	2	3	4	5	6	7
Strongly DISAGREE						**Strongly AGREE**

Then, the respondent was asked to elaborate on the reasons for his markings. This is consistent with the recommendation of White (2000) that qualitative research should not simply describe a situation but also look for explanations and analyses. In this way, although the survey is descriptive and qualitative in nature, it also contains an element of quantitative analysis. Indeed many authors advocate the use of both qualitative and quantitative methods. Sechrest & Sidani (1995) are of the view that "*methodological pluralism*" should be encouraged while Marsland et al., (2000) provide a methodological framework for combining quantitative and qualitative survey methods. The questionnaire ends with an open-ended question so as to introduce other issues that may not have been covered by the 10 core questions.

5.5 The Interview Design

Each interviewee was given a copy of the 10 prescribed interview questions a few days before the interview which itself was carried out in the interviewee's office and therefore in '*actual and everyday settings*' (White, 2000, p. 28). In addition, each interview was asked whether they minded that the discussion be audio-taped. None of them objected to this request. Each interview lasted between 30 and 45 minutes

and in addition to the audio-taping, ‘memoing’ was used to note down reflective notes as the discussion went along. In some cases, the order of the questions was not adhered to, depending on the interviewee’s preference. For each question, the interviewee was allowed to elaborate on the reasons for his grading and here, care had to be exercised to avoid wandering away from the subject matter. For each question, the reasons given were summarised by the author and the interviewee asked to agree or not with the summary. Although this lengthened the interview process, it helped in strengthening the validity of the findings. The final question invited the interviewee to speak about any related matter, in particular, on his/her attitude and perception of setting up a Science Park in Mauritius. Although English was the main language medium used for the interviews, at times both French and Creole were also used to clarify certain issues. At the end of the process, the interviewee was thanked and reminded that he/she would be able to have access to the findings.

5.6 Pilot Study

A pilot study was undertaken to test the interview instrument. Given the smallness of the sample, only one interviewee was selected for the pilot study. The interviewee chosen was a bank manager who, being a non-technical person, provided useful insight into the approach to be employed in explaining the concept of a Science Park. This exercise led to some refinements in the description of the Science Park and its objectives. In addition, it was found that terms such as technology absorption and intellectual property rights had to be explained in detail for these to be understood. Although the pilot interview was mostly carried out in English, the study showed that French and the local Creole had to be used at times so that the concepts are fully understood. It was also found that using some French and Creole resulted in a more

relaxed and informal environment in which the interviewee became more involved and thus more revealing on the issues being discussed. The study also helped in timing the interview. The wish was that it should not exceed 1 hour. A major change to the questionnaire, further to the pilot study, was the addition on an 'entry-question' by asking the interview for his/her general perception with regard to the status of science and technology in Mauritius. It was found that this allowed a 'smooth entry' to the interview. Another finding was that in some cases, the interviewee preferred to grade his/her answer only at the end of his/her reply rather than at the beginning.

5.7 Validity and Reliability of the Survey

Validity as described by White (2000, p.25), "*is concerned with the idea that the research design fully addresses the research question and objectives*". This particular survey aims at providing answers to ten questions which were derived by examining the impact of setting up a science park in Mauritius within the framework of Porter's diamond model of competitiveness. Therefore, the survey is valid as it addresses the research question directly. The internal validity of the questionnaire was improved by the pilot study which provided useful feedbacks which led to new simpler explanations of some of the technical terms to be used in the interviews.

White (2000, p.25) describes reliability of the research as being consistent and "*whether another researcher could use your design and obtain similar findings*". White (2000) also points out that interpretations of the findings can vary depending on the researcher's judgement. In the current survey, given the same questionnaire guide, it is felt that the results could be reproduced if the characteristics of the sample are maintained and the context is similar. Hence the survey is considered to be reliable.

5.8 Ethics and Confidentiality

Each Interviewee was fully briefed with regard to the objective of the interview. The academic nature of the exercise was emphasized upon. The prescribed questions were forwarded to the interviewees a few days before the interview so that they could turn down the interview if so they had wished. It turned out that none of those who were approached refused to be interviewed. Each interviewee was told that the exercise could take up to one hour and that their names and contributions would remain very confidential. In addition, the final report would not contain any names of interviewees, only their professions.

5.9 Author's objectivity

The author being himself the Director of the Mauritius Research Council, would be directly involved should a Science Park be set up in Mauritius. This situation called for great care on his behalf in order not to introduce any biasness which may reflect the position of his institution. To that effect, the design of the interview questions was solely based on the outcomes from the Porter's model of competitiveness and from secondary data analysis, as discussed in the previous chapter. In the same vein, all interviews were conducted at the interviewee's place and during which the author did not express any views on the subject matter, except for pertinent interventions to guide the discussion.

5.10 Qualitative Data Analysis

5.10.1 Data Condensation, Coding and Categorizing

The data analysis was largely based on the methods described by Basit (2003), Thomas (2003) and OnlineQDA (2009). All the data were audio-taped and transcripts of the main points of the discussions were produced in a matrix form. Some of the

transcripts are given in Appendix Three. This form of '*data condensation'*, as recommended by Thomas (2003), provided '*an anatomic framework of the data permitting instantaneous contrast*' between the responses to the questions. This approach also allowed the data to be segmented into a series of descriptive codes or themes each representing '*a meaningful segment'* of data. Some of these codes were '*a priori-codes'* such that they are based on previous studies and the literature survey. The others were '*inductive codes*', also known as '*grounded codes'*, such that they were formulated directly from the data. Most of the codes presented here are inductive as these are not affected by '*prejudices*'. Following the approach used by Thomas (2003), the codes or themes were then grouped to form 'categories', which is equivalent to a further reduction of the data. Some of the codes could be applied to more than one category, depending on the circumstances (Thomas 2003). In particular, the grouping of the themes or codes was based on the relationships between the codes and the criteria used for the groupings were those of Spradley's Universal Semantic Relationships (cited in www.southalabama.edu) given below:

	Title	**Form of Relationship**
1	Strict Inclusion	X is a kind of Y
2	Spatial	X is a place in Y; X ia part of Y
3	Cause-effect	X is a result of Y; X is a cause of Y
4	Rationale	X is a reason for doing Y
5	Location for action	X is a place for doing Y
6	Function	X is used for Y
7	Means-end	X is a way to do Y
8	Sequence	X is a step (stage) in Y
9	Attribution	X is an attribute (characteristic) of Y

Table 5.1 Spradley's Universal Semantic Relationships.

5.10.1 Hierarchical Categories and Network Diagrams

The present qualitative survey also included a quantitative element whereby the interviewee was requested to grade, on a scale of 1 to 7, his/her agreement to given statements pertaining to the roles of the Science Park. In the analysis that follows, the result of this grading exercise was used to prioritize the different categories that emerged from the grouping of the themes or codes. This resulted in a set of hierarchical categories which was finally presented in the form of a net work diagram to illustrate the various relationships among the categories. In this manner, a set of potential roles for the science park was formulated from the qualitative data analysis.

5.11 Results and Discussion

The results of the data analysis are presented under the headings of the following five main categories which emerged during the data coding and grouping exercises. These categories are later networked in a hierarchical manner with other sub-categories to form a network diagram illustrating the potential roles of a Science Park in Mauritius.

5.11.1 Enabling Factors

During the interview, it became obvious that the setting up of a performing Science Park could only be feasible in the presence of ‘enabling factors’ which resulted from the following grouping of codes which also shows the Spradley’s relationships:

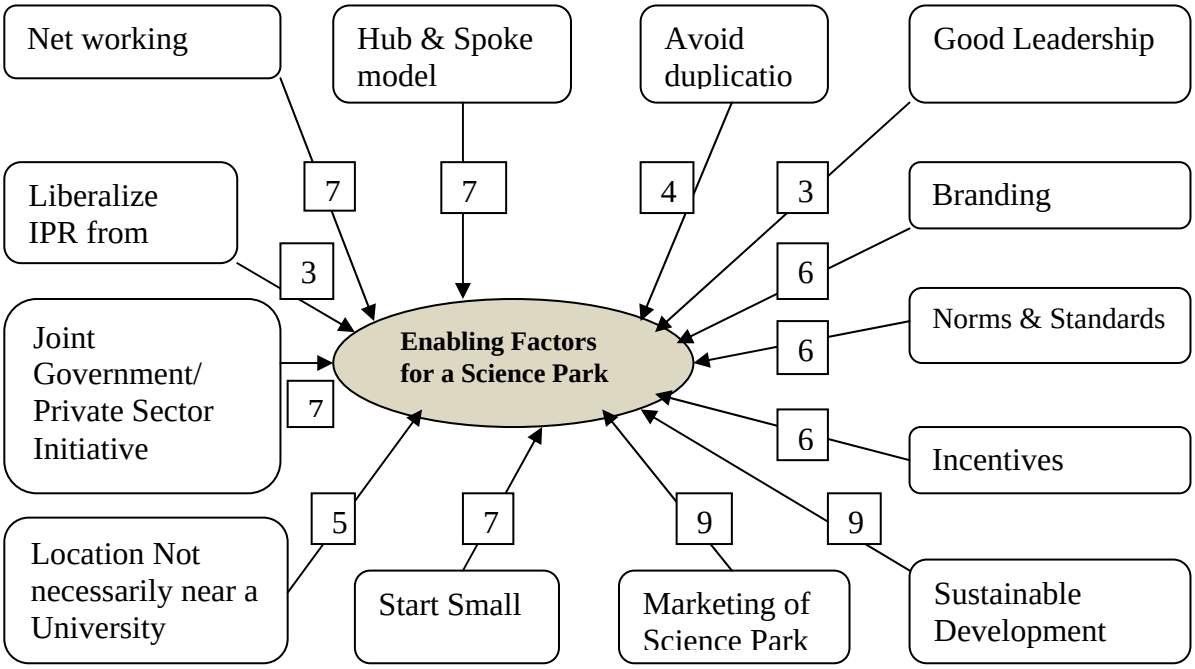

Figure: 5.1 Category 'Enabling Factors'

Most of those interviewed had strong views that the creation of Science Park should not duplicate the functions of existing institutions but operate as a 'Hub & spoke' model thereby enabling networking among concerned institutions while playing a central coordinating role. In that respect, the Park needed not be located explicitly next to a university. The Park should also start small, focusing on '*sustainable development'* projects and has good leadership to promote its services which should be branded and of high norms and standards. In addition, the setting of the Park should be a joint Government/ Private sector initiative and Intellectual Rights Properties emanating from Government research funding should be liberated and made available to the researcher and the research institution concerned. Finally, the success of the Park would depend strongly on the attractiveness of the incentives offered. These enabling factors were felt to be a priori for the successful development of the Park.

5.11.1.1 Peculiarities of Small Island states

Of the above enabling factors, five stand out as 'push factors' and sine-qua-non in the particular context of Mauritius, the small island state. **First**, the 'hub & spoke' model implies a net working approach rather than a stand-alone building acting as a Science Park. This is in contrast to the model existing in many countries whereby Science Parks are '*extensions*' to the academic setting of universities and are self-contained parks. The **second factor**, which is linked to the first, is the fact that the Science Park needs not be physically close to a university. These two factors are also present in the Singaporean model and are consistent of small island state particularities. Indeed, as Koh et al., (2005) describe the situation in Singapore; "*The whole island can be considered as a Science Park*". Moreover, in their review of Science Parks in UK, Quintas et al., (1992) point out that "*Geographical proximity to academic research is not considered necessary in the case of collaborative R&D*". What seems to be important to promote innovation is a collaborative framework based on national objective. This view, however, is in contrast with that of Luger and Goldstein, as cited by Felsentein (1994), and who opined that "*Parks located in small areas and without university connections are the most likely to fail*". The case for Mauritius is that due to its small island dimension, its Science Park will always be physically close to a University, although not "*necessarily attached*" to one.

The **third factor** which is important is the issue of Intellectual Property Rights (IPR). Although all the interviewees agreed that Government should give away the IPR, most, however, were of the view that Government should retain some of the IPR and not give the entirety of it as is the case in the US (Siegel et al., 2003). The quantum of the IPR to be retained could be a function of the size of the funding. The **fourth** enabling factor which is deemed very important is the fact that the Science Park

should be a joint Government/Private Sector initiative. Again this is different, say to the Malaysian model (Ramasamy et al., 2004) and those of Nordic countries (Rasmussen et al.,2006) as well as those based in Taiwan(Yang, 2009) and China (Lai & Shyu, 2005), where the Science Park is an entirely Government funded and led enterprise. The rationale for a joint initiative in Mauritius seems to be that of effectiveness and the involvement of the private sector in the governance of the Park. The **final enabling factor** is that of the need to focus on projects of sustainable development and avoid polluting industries. This is consistent with the requirement to brand products emanating from the Park.

5.11.2 Promote Entrepreneurship

The second category which emerged from the groupings consisted of codes as shown below and where Spradley ‘s relationships are also indicated:

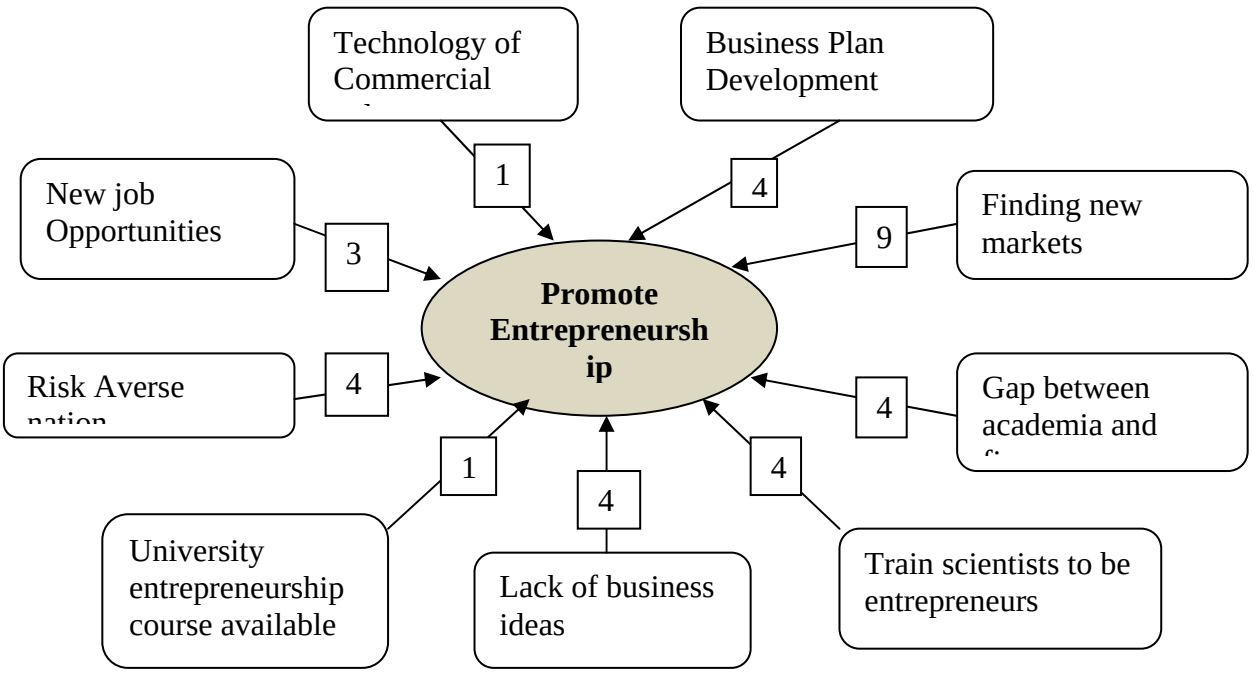

Figure 5.2 Category “Promote Entrepreneurship”.

This category groups together a number of like issues and recommendations pointed out by those interviewed with regard to entrepreneurship. The category leads to a potential and desired role of the Science Park in the promotion of entrepreneurship which appeared to be lacking in an island which is perceived to be 'risk-averse' in business and did not have enough 'science-oriented' job opportunities.

5.11.3 Promote Interest in science

As shown below, this category assembles codes which described the status of science and technology on the island and highlights some of the problems and the recommended measures to be taken.

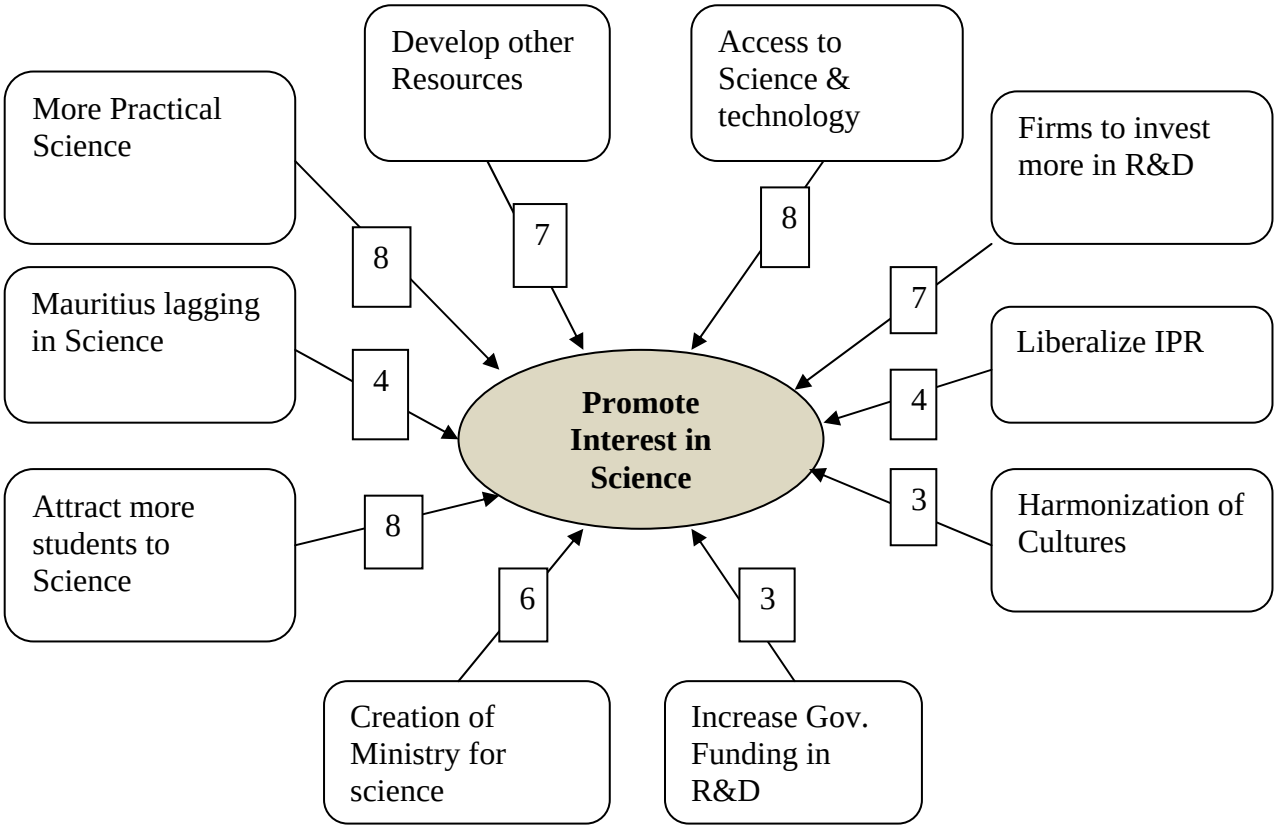

Figure 5.3 Category "Promote Interest in Science".

In essence, this category leads to a role of the Science Park in enhancing the country's interest in science, realizing that future development would depend on investment made in science and technology. An interesting contribution is that

science could assist in harmonizing the multi-cultural society of the island, being given the Cartesian nature of science, and thus dispelling any assumed cultural mystiques. A prime requirement in this category in the needed increase in government expenditure in Science and Technology as well as the need for the private sector to also invest more in R&D.

5.11.4 Create Science Job Opportunities

Job creation was seen to be "a must" in the role of the Science Park. "*Many young students are not attracted to science subjects because of the lack of related job opportunities*". In addition, the Science Park would "*showcase the practical and commercial sides of science education*". In this context, the Science Park was perceived as an instrument to attract foreign technological expertise and investment and thus leading to scientific job creation. Its setting up would be "*sending the right signal*" that Mauritius was technology ready for high tech-enterprises as well as for Multi-National Companies (MNC's). The figure below shows the grouping for that particular category.

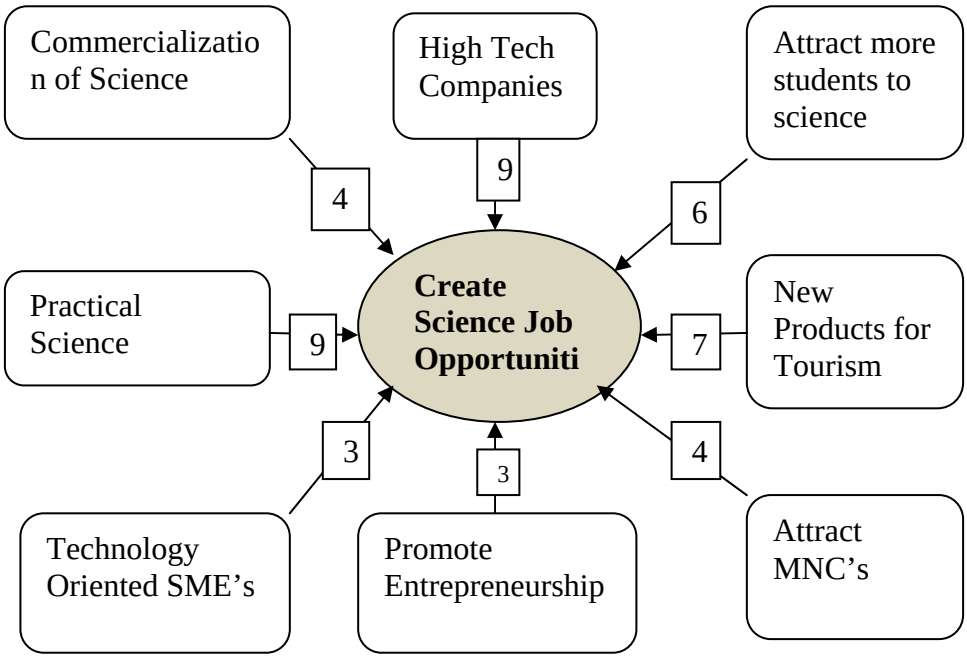

Figure 5.4 Category "Create Science Job Opportunities"

5.11.5 Develop Other Resources

A number of issues were identified with regard to the "*lack of natural resources*" and the need for "*sustainable development*" of the island. To that effect, development of the maritime space of the island and the exploitation of renewable energy were seen to be major sources of income that the Science Park could play an important role in promoting. In this way the country could diversify its pillars of economy as well as increase its exporting capability, particularly to the neighbouring SADC countries. The diagram below shows the grouping for this category.

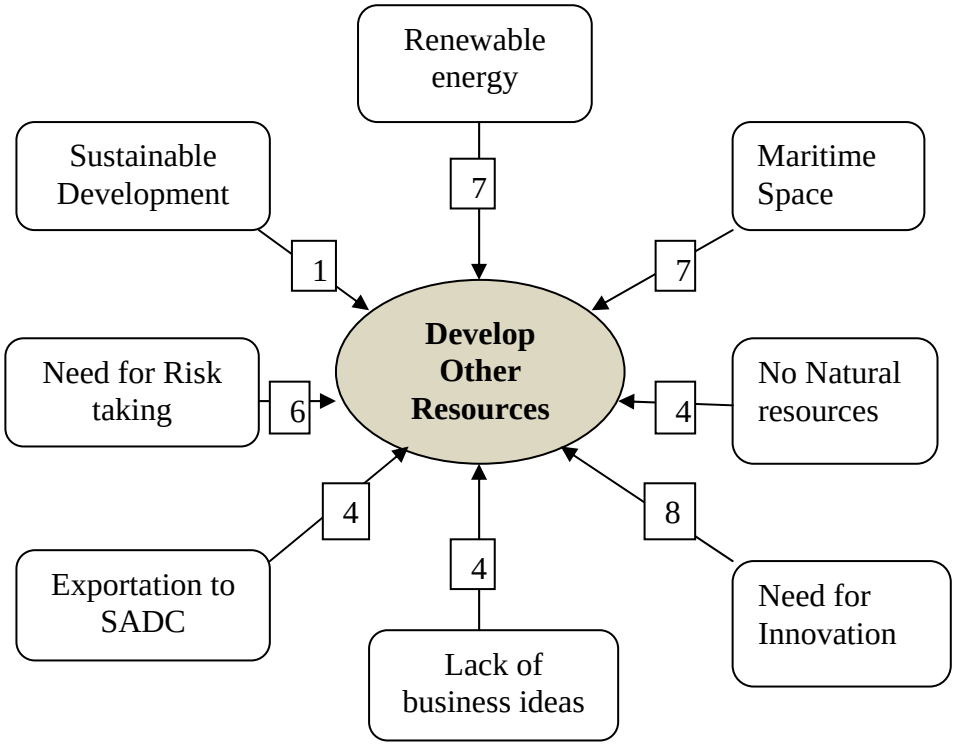

Figure 5.5 Category "Develop Other Resources"

5.12 Roles of the Science Park through a Network Diagram

In order to use the above findings and display the different potential roles of the Science Spark in a hierarchical network diagram, the results of the quantitative element of the interviews were used. The following chart shows the order to which

the interviewees agreed or not to the 10 core questions pertaining to the roles of the science park and thus to the above categories.

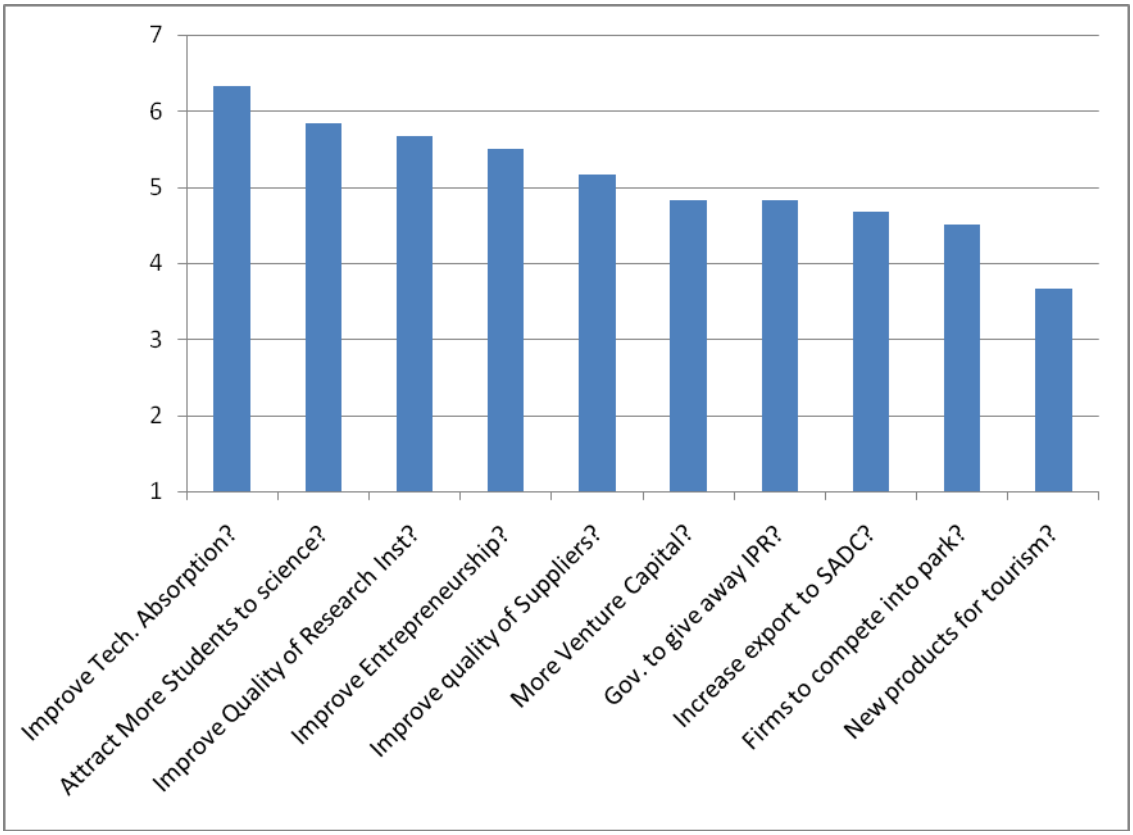

Figure 5.6 Average Responses to 10 core Questions (1= strongly Disagree; 7= Strongly Agree)

From the above it is noted that the perceived primary role of the Science Park is to improve the technology absorption capacity of the island. Indeed, all the categories discussed above, as well as the 'enabling factors' lead to better technology absorption capability of the island. This advanced factor condition, also discussed in the previous chapter, turns out to be the main role of the Science Park. However, it requires other supporting roles of the Science Park for it to be effective. By using the results of the previous section as well as Figure 5.6, the following network diagram which depicts the main roles of the Science Park was derived:

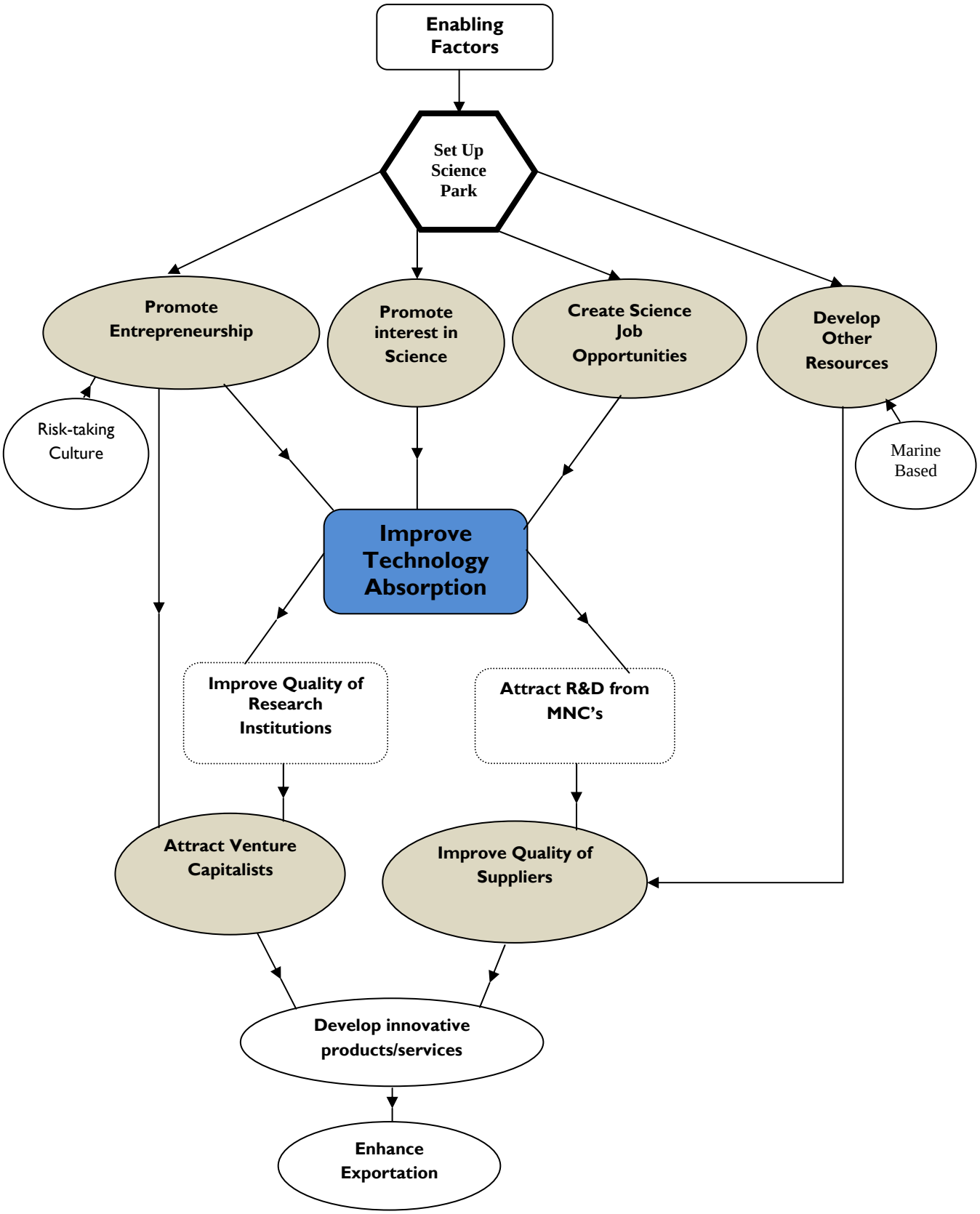

Figure 5.7 Network Diagram showing the roles of the Science Park

From Figure 5.7 it should be pointed out that although the main role of the Science Park is to increase the technology absorption capacity, this role has to be supported by the enabling factors and the four roles described in the above Section 5.11. Only then will technology absorption take place and lead to improvement in the quality of research institutions and attraction of Multi National Companies. Subsequently, these two sub-roles will in turn lead to increased interest from Venture Capitalists and in improvement in the quality of suppliers. Finally, all these roles will culminate in the development of innovative products which will enhance the exportation potential of the island. In addition the roles are complementary and all are interlinked and therefore necessary for the successful operation of a Science Park. Because of the non-linear relationships among the different roles and the fact that they react to both pull and push factors, deficiencies in any of one of the roles could affect the entire system and thus the overall performance of the Science Park. To summarize, the effectiveness of a Science Park to contribute to the competitiveness of the country is systemic in nature and cannot be examined in isolation of the various roles that the Science Park is to play.

The network diagram of Fig. 5.7 also offers a framework within which the performance of a Science Park can be assessed. Two cases are considered to illustrate the use of the framework. The first pertains to the apparent failure of three Science Parks based in Greece (Bakouros et al., 2001) due to their poor relationships with universities and small sizes as well as their “letting-in policies” to select firms to be located in the Park. From the framework of Fig. 5.6, it could be deduced that perhaps a networking approach among existing institutions as proposed by the enabling factors, to create the Science Park could have been more effective to overcome the problem of size associated with individual Science Parks.

Likewise, a ”letting-in policy” based on themes such as sustainable development and on exploitation of new resources might have attracted innovative firms.

The second example is that of Singapore which operates a very successful Park. In this model, a prominent feature is the ability of the Park to attract MNC’s through the availability quality research institutions and access to a high quality supplier industry and to the huge Asian markets; all of which features are in the proposed framework.

5.12 Conclusions

This chapter used the 10 core questions developed from Porter’s competitiveness model to design a structured face-to-face interview to assess the views and attitudes of key decision makers and professionals in Mauritius in order to formulate a set of roles that a Science Park ought to play in order to improve the competiveness of Mauritius. The audio-taped qualitative data were coded and categorized and this process led to a network diagram which defines the inter-relationships among the various expected roles of the Science Park. In particular, it was found that the setting up of the science Park could only be feasible if a set of enabling factors were present. These include, among others, the part-liberalization of IPR from government research funds and branding of the park. However, the prime expected role of the Science Park should be to raise the technology absorption capacity of the island. This can only be achieved through other supporting roles to be played by the Science Park, such as promote entrepreneurship, increase interest in science, create science-related job opportunities and encourage the sustainable development of other resources. In addition, the science Park should attract MNC’s leading to increased exports. A major finding is that the Science Park should be based on a “Hub & Spoke” model whereby it plays the central role of coordinating existing institutions,

such that overlapping of functions are eliminated and the whole island can be a science park. Finally, it is postulated that the framework developed in this chapter could form the basis to assess the performance of Science Parks. The next chapter makes use of the set of desired roles of the Science Park to develop a quantitative survey of small and medium enterprises with a view to defining the desired functions and services to be offered by the Science Park.

Chapter 6: Quantitative Survey of Enterprises on the Services of the Science Park

6.0 Introduction

In the previous chapter, a qualitative survey of key decision makers in the island of Mauritius was used to provide answers to ten core questions emanating from applying Porter's diamond model to analyze the impact of setting up a Science Park on the competitiveness of the country. The qualitative analysis resulted in the formulation of a set of anticipated roles for the Science Park. In this chapter, these roles are used as the basis for a quantitative survey of enterprises with a view to defining and prioritizing the functions and services that a Science Park ought to fulfil in the context of the small island state Mauritius and its market requirements. The chapter describes the objectives of the survey, the sample design and the questionnaire design. The data collected is statistically analyzed and the results discussed and presented as a set of prioritized services which enterprises in Mauritius consider to be important for the Science Park to offer. Finally, the desired financial model and governance as well as the infra-structural set up for the sustainability of the Science Park are elaborated upon.

6.1 Objectives of Survey

a) To use the set of anticipated roles to formulate questions with regard to the services to be provided by the Science Park in order to respond to the needs and aspirations of enterprises in Mauritius.
b) To assess the Entrepreneurs' perception of the status Science & Technology in Mauritius.
c) To gauge and measure the extent of technology awareness, access and use in enterprises in Mauritius.

d) To identify the constraints in creating new businesses in Mauritius.
e) To triangulate the findings of the qualitative survey of the previous chapter.
f) To derive a set of prioritized services to be provided by the Science Park and which fulfils the needs of the enterprises.
g) To determine the desired model of governance and financing for the Science Park.
h) To propose an appropriate infrastructural set up for the Science Park.

6.2 Choice of Research Method

The choice of the research method was dictated by the requirement to quantify and prioritize the views, constraints and needs and aspirations of those wishing develop new technology-oriented businesses as well as upgrading their existing businesses through innovation. According to Weinrich (1996), '*quantitative methods are most appropriate for conducting needs assessments*'. Therefore, a quantitative method based on a questionnaire designed to collect the required information was selected. Although quantitative methods have been criticized for their apparent '*de-contextualization of human nature in a way that removes the event from its real world setting'* (Weinrich, 1996), in this particular study, given the size of the sample data (see below), only a quantitative approach was justifiable. In addition, this methodology offers '*objectiveness*' as the researcher is considered '*external to the actual research*'. Moreover, as a qualitative technique was used in the previous chapter, the use of a quantitative approach enabled some of the findings to be '*triangulated*' (White, 2000, p. 41), and therefore added to the complementarily of the study as a whole. Finally, with a quantitative approach relationships between variables can be deduced and these could be helpful in devising prediction tools.

6.3 E-mail Survey Method - Pre-Notification & Reminders

With a view to targeting a representative sampling frame and obtaining a rapid response while minimizing the cost of the survey, the e-mail survey methodology was used. As pointed out by Kaplowitz et al. (2004), this approach eliminates printing and mailing of the survey instrument and also leads to time and cost savings as the responses are returned back also in the electronic format. As only extremely few companies do not have an email address, it is felt that this approach covered almost the entire of the targeted companies. In addition, in order to improve on the response rate, the recommendation of Sheehan (2001), to send pre-notification of the survey to the companies targeted was applied. Furthermore, two reminders were sent before the deadline which was set to two weeks after mailing of the questionnaire.

6.4 Sampling frame

Enterprises in Mauritius, like anywhere else in the world, are either in the formal sector or in the informal sector; the latter being a sector that is generally unrecognized, although it does contribute to job and wealth creation (MRC, 2000). The present study targets the formal sector which involves registered companies. These can be sub-divided into ‘large’ enterprises and the ‘Small and Medium Enterprises’ (SME’s). In Mauritius, an SME is officially defined as an organization which employs less than 10 persons and whose revenue does not exceed Rs 10 million per year (SEDHA Act, 2005). SEDHA is an association which groups all the SME’s in Mauritius.

The sampling design needed information pertaining to enterprises and this was obtained from the major umbrella organizations in Mauritius which group together companies from different sectors. For example, ‘Online ICT Operators’ is an

association of companies operating in the ICT sector. The biggest umbrella organization, however, is the Mauritius Chamber of Commerce and Industry (MCCI) which groups over 400 ‘large’ companies from various sectors including banking, tourism, commerce, insurance and industry. For the purpose of this study which pertains mostly to technology-oriented companies, only those in the INDUSTRY sector of the MCCI were selected. In addition, since the survey instrument would be communicated through e-mails, only those companies which have an e-mail address were selected. Based on these criteria, the sample frame of the enterprises to be surveyed was as shown below.

	Umbrella Organization	**No. of companies with e-mail**
1	SEDHA (Small & Medium Enterprise Association)	222
2	Online ICT Operators	72
3	Mauritius Chamber of Commerce and Industry (MCCI) (Industry Sector Only)	116
	TOTAL	**410**

Table 6.1 Sampling frame of Enterprises

The sampling frame did not include those companies grouped under the Mauritius Chamber of Agriculture, which caters mostly for companies in the sugar sector and for which there is already a dedicated Sugar Science & Technology Institute (MSIRI, 2000). The e-mail survey targeted all the units of the above sampling frame.

6.5 Questionnaire Design

The design of the questionnaire (and the covering letter) was driven by the need to attract the attention of the respondent and prepare a ‘smooth entry’ into the subject matter. The formal use of the LOGO of the Mauritius Research Council and the

covering letter from the Executive Director of the Council addressed to the CEO or Managing Director (Appendix Four) helped in creating an ‘official’ request to the respondent.

The questionnaire itself is divided into 6 main sections as shown Fig. 6.1. The rationale was to use the roles of the Science Park as well as the enabling factors for the setting up of the Park as determined in the previous chapter, to gauge the perception of the status of science and technology in Mauritius, so that this can be corroborated with data obtained from the previous qualitative survey. In addition, data pertaining to technology awareness, transfer and use were also requested. The frequency and quality of the interactions with the local university and research institutions were prompted for with a view to identifying any gaps in the academia-industry linkage. In a similar vein, the difficulties encountered in creating new technology-oriented enterprises were probed into. The objective was to assess the extent of the void that a Science Park would have to fill and thereby leading to the desired services to be offered by the Park. Throughout the questionnaire, constant references were made to best practices in Science Park in other countries. In particular, selected services offered by the various incubator models described by Grimaldi & Grandi (2005) were presented to the respondents for their views. In this way, Science Park services as practiced in other countries could be assessed for their anticipated effectiveness within the Mauritian context. Finally, having pondered upon the services that the Science Park could provide, the respondent was asked to select the financial model, the governance and the structure of the science Park that would best suit the Mauritian context.

With a view to shortening the respondent's time, almost all questions used a Likert scale which required only a tick while also enabling the responses to be prioritized. Extremely few questions were open ended. The full questionnaire is given in Appendix Five. It was designed such that it could be printed and the manually filled-in questionnaire faxed to the Council. However, the stated preferred mode of completion and return was to use the soft version and complete the form in 'Word' before e-mailing it back to the Council.

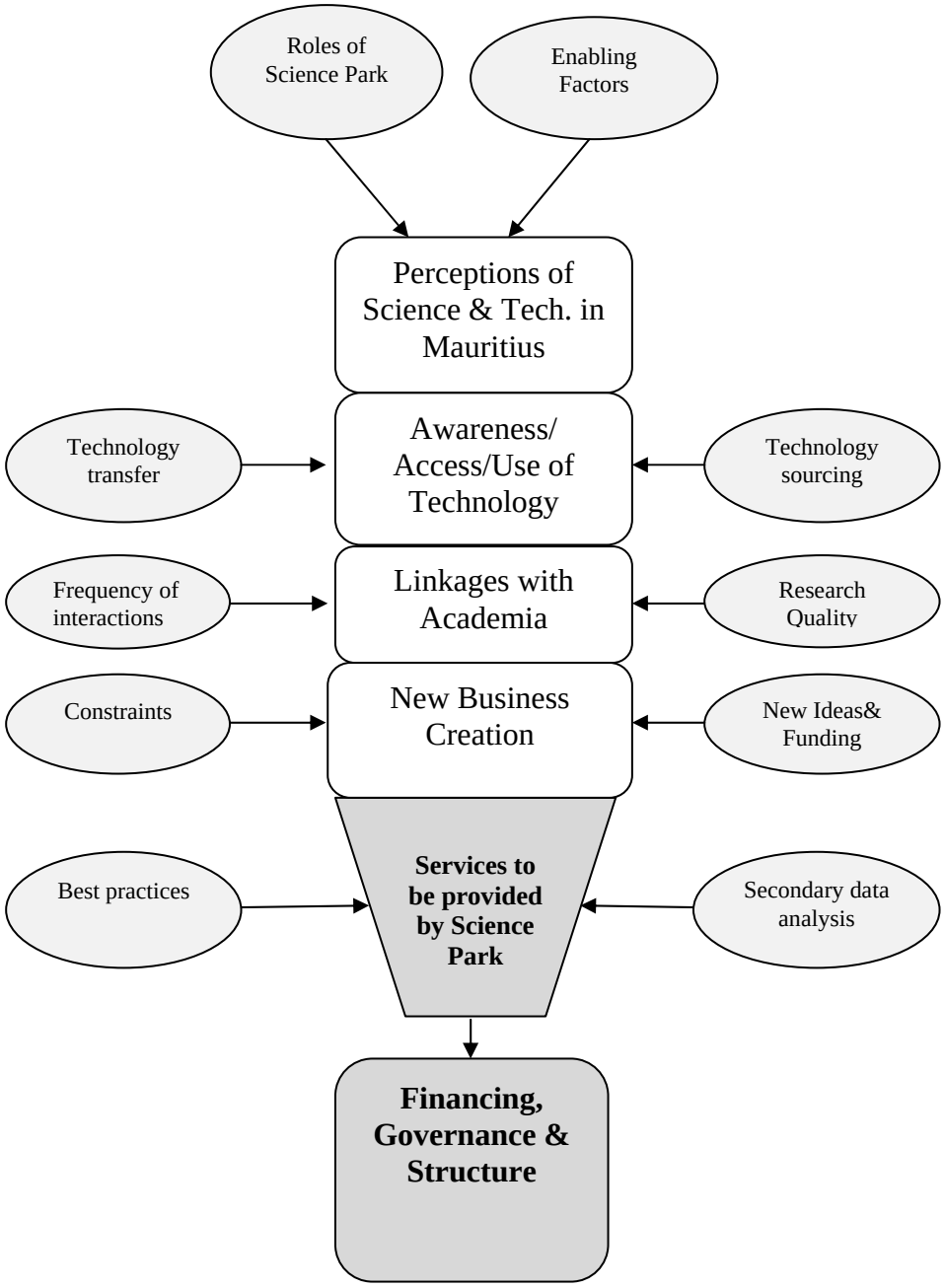

Figure 6.1 Salient Features of Questionnaire Design for Survey of Enterprises

6.6 Pre-testing of survey Instrument

A pre-test of the survey instrument was conducted on a small sample of 5 managers. Although this did not reveal major flaws in the questionnaire design, it was however, useful to check the time required to fill in the questionnaire both manually and on-line as a ‘word-document’. As a result, the time required was estimated to be between 20 to 30 minutes.

6.7 Response Rate

In addition to the pre-notification to the survey as well as the two reminders, many of the enterprises were also contacted by telephone in order to prompt a reply. However, it was found that many (142) of the company e-mails listed in the latest edition directory of 2008 were either ‘unknown user’ or ‘Account Expired/Exceeded’ and therefore non-functional. These companies were mostly in the category of small and medium and presumably many have either shut down or change business. Only 109 companies acknowledged ‘Read receipt’ of the survey instrument. Out of these, 39 completed responses were obtained by the set deadline. Therefore, one can assume a response rate of 36% which is deemed satisfactory

6.8 Statistical Tools

The software packages used for the statistical analysis were STATSTOOL, EXCEL and SPSS. In particular, SPSS was required as neither EXCEL nor STATSTOOL had all the necessary statistical functions such as Spearman’s r, etc.

6.9 Respondent's Profiles

The 39 companies which responded can be categorized as follows:

Category	Remarks
Sector	Manufacturing or ICT
Size	Small (<10 staff); Large (>100 staff)
Revenue (Rupees)	Small (<15 Million); Large (> 100 Million)
% of Science or Technical Staff	Small (<2%); Large (>50%)

Table 6.2: Categories of Respondents

In particular, the detailed breakdown is as shown below.

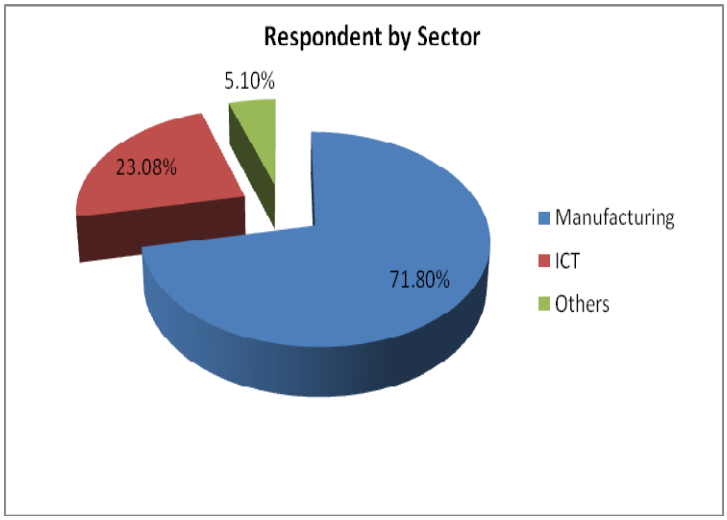

Figure 6.2 Respondents by Sector of Operation

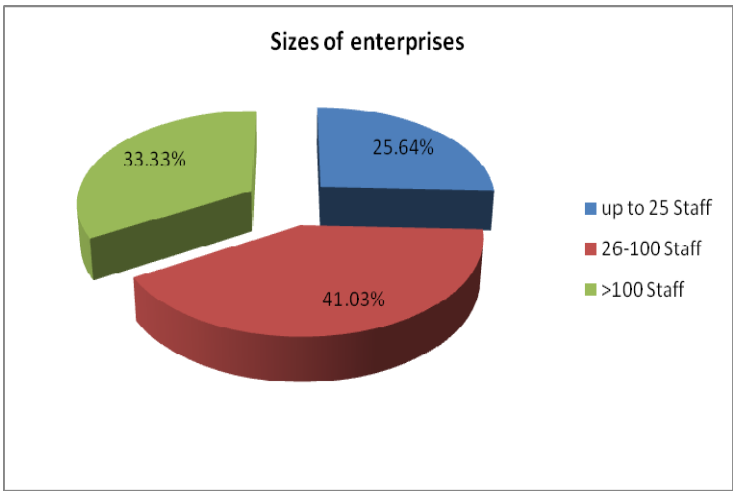

Figure 6.3 Respondents by sizes of enterprises

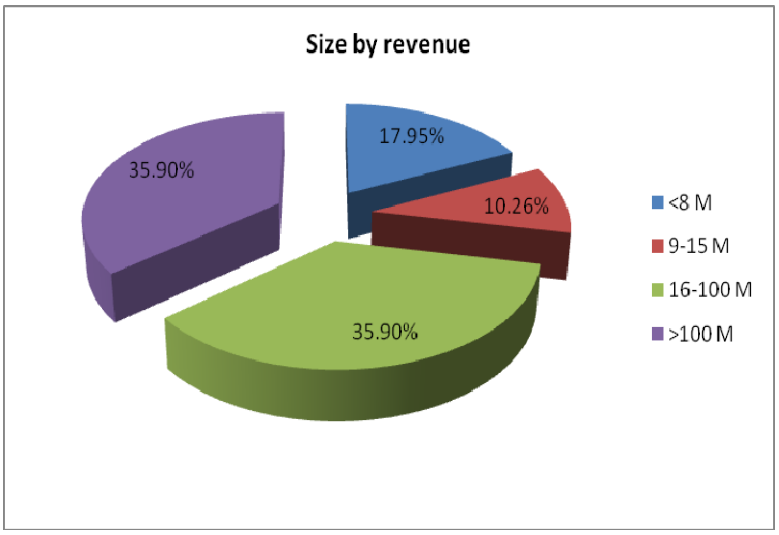

Figure 6.4 Respondents by size of revenue (Million Rupees)

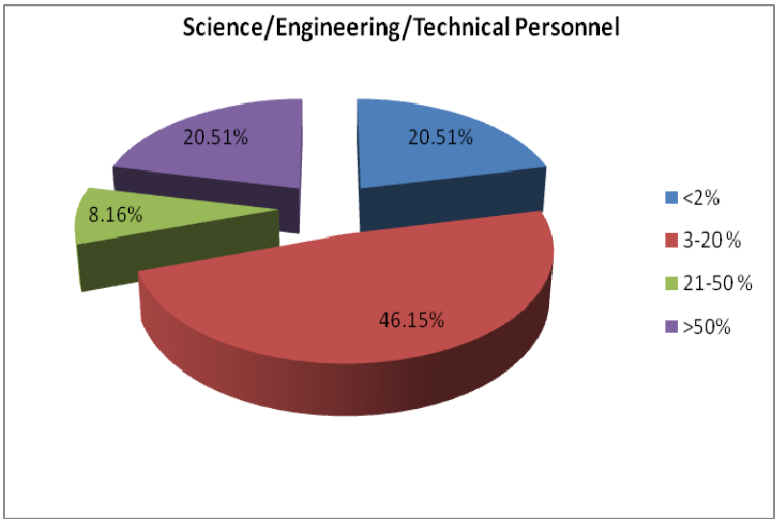

Figure 6.5 Respondents by staff qualifications

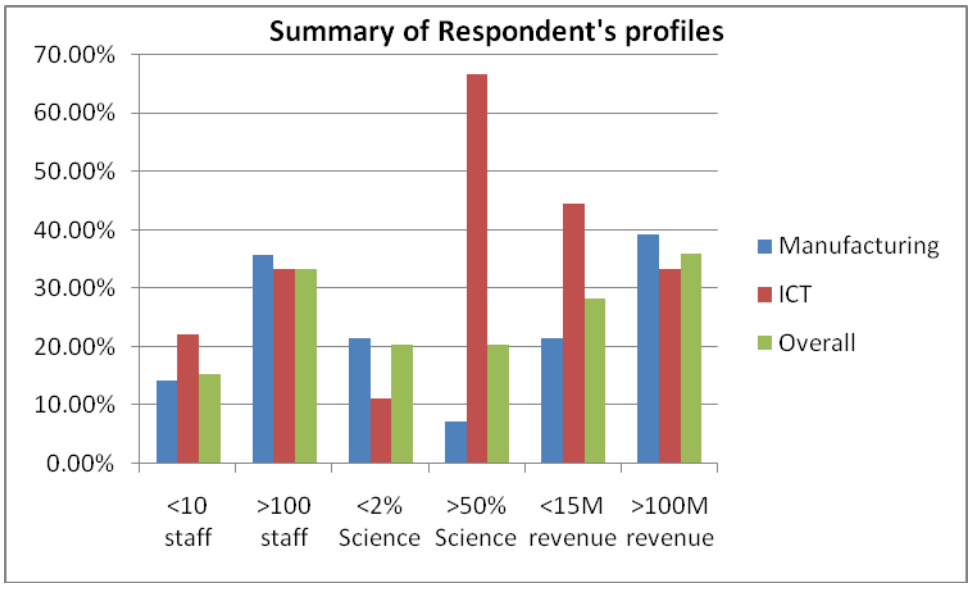

Figure 6.6 Comparisons of Respondents' Profiles

From the above, it is noted that most of the 39 respondents are from the manufacturing sector (28). In terms of number of personnel, most companies fell in the ‘Medium’ category employing between (26-100) staff. A third of the respondents were ‘large’ companies employing more than 100 employees. In terms of revenue, about 18% of the respondents were ‘small’ enterprises generating less that 8 million rupees annually. Large enterprises generating over 100 million rupees constituted about 36% of the respondents. Overall, about 20% of the enterprises had less than 2% of their staff with science or technical qualifications. Also, about 20% of the respondents had over 50% of science/technical staff. Science staff was mostly employed in the ICT sector with over 65% of the ICT firms having more that 50% of their staff with science/technical qualifications. In the manufacturing sector, only about 7% of the companies had over 50% of science staff.

Due to the absence of details regarding the firms in the sample frame, a comparison with the 39 responding firms cannot be made. Consequently, it is difficult to establish with any statistical accuracy, the representativeness of the 39 firms as constituting a valid random sample. For this reason, most of the discussions that follow are based on descriptive analysis without inference on the population.

6.9.1 Perceptions of the Status of S&T in Mauritius

The second part of the questionnaire pertained to assessing the perceptions of the enterprises with regard to the status of Science and Technology (S&T) in Mauritius. In particular, views were sought on issues related to investment in S&T, interest in S&T education, job opportunities in S&T, quality of research institutions and the potential impact of S&T on the economy. The findings are summarized in Figure 6.7.

Over 60% of the respondents were of the view that Mauritius was lagging in S&T development compared to other similar countries. 80% thought that Government did not invest enough in S&T while 56% thought that the private sector did not invest enough in S&T. In general, almost 90% of the respondents agree that more S&T will be beneficial to the economy in enhancing exportation, improving the supplier industry and attracting MNC's.

With regard to science education, 53% of the respondents were of the view that students were not attracted to science subjects at schools while only 28% thought otherwise. The job market for those with science background seemed to be small as only 30% felt that there were science-related jobs. Moreover, only 38% thought that science-related jobs were better paid.

The quality of the research institutions was judged to be good by only 33% of the respondents. Finally, with regard to the exploitation of new resources such as marine and renewable energy, respectively, only 18% and 13% of the respondents thought that the country had the relevant S&T expertise.

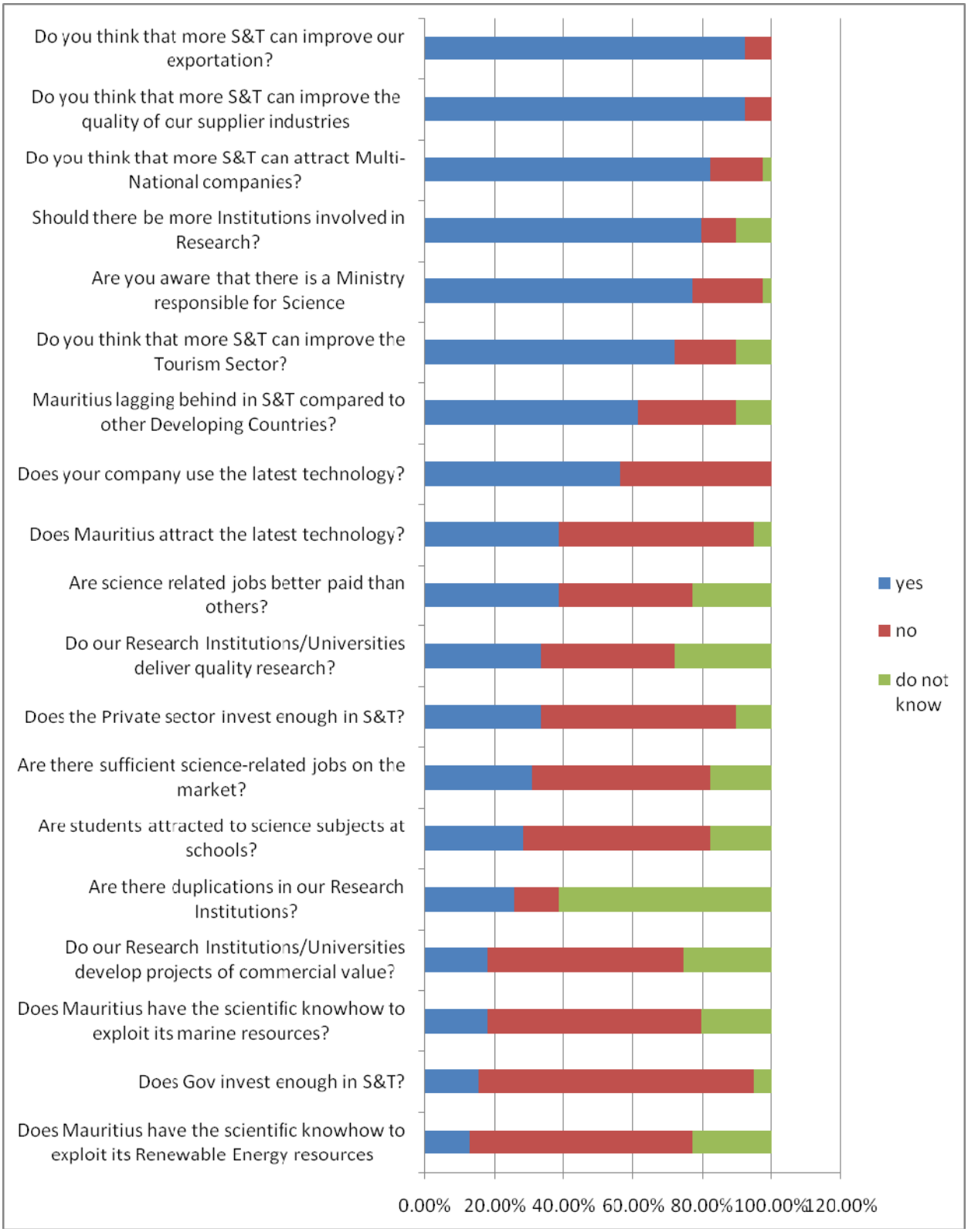

Figure 6.7 Respondents' Perceptions of the Status of S&T in Mauritius

6.10 Current Sources of Scientific/Technological Information

The third part of the questionnaire aimed at assessing and prioritizing the current sources where firms have access to new technology. The objective was to identify gaps which the Science Park could address. The results are summarized in the following chart:

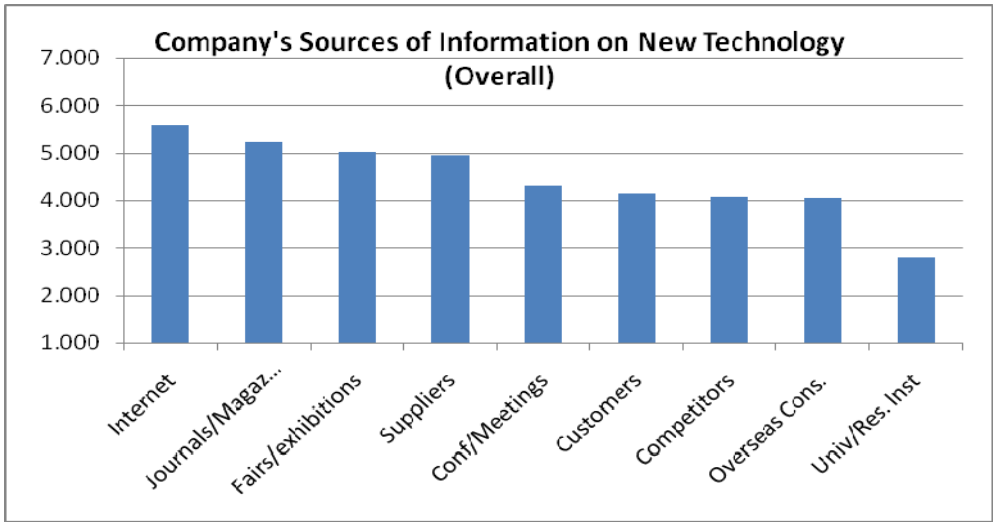

Figure 6.8 Sources of Information regarding new technology (1=Not Important; 7 Very Important)

As can be seen, the internet is the prime source of information regarding new technology. One also notes that the university and the local research institutions are the least source of technological information. However, this statement reflects the overall situation. When the analysis is carried out on the basis of the sector concerned and the size of the enterprises, the results are slightly different as shown below:

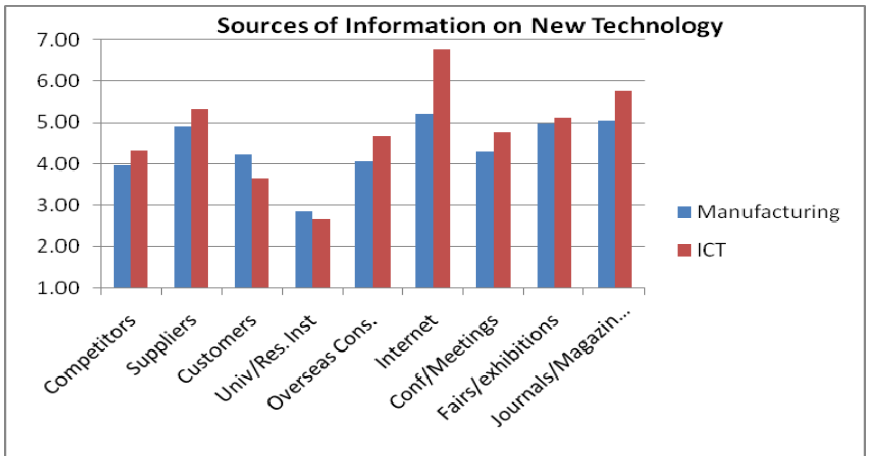

Figure 6.9 Sources of Information regarding new technology (1=Not Important; 7 Very Important)

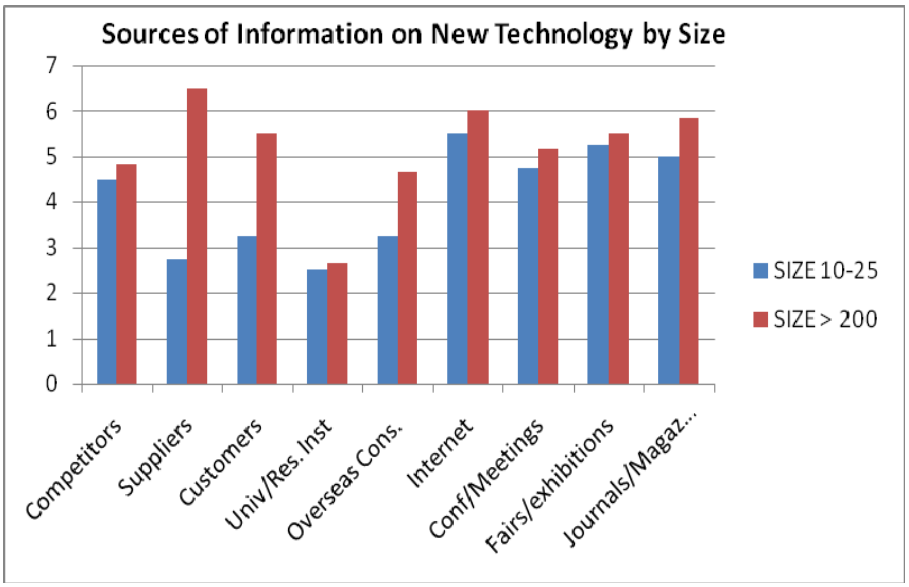

Figure 6.10 Sources of Information regarding new technology (1=Not Important; 7 Very Important)

The following can be deduced from the above:

a) The internet is the most common source of information regarding new technology. Firms in the ICT sector use the internet more than those in the manufacturing sector. Large organizations (staff >2000) make more use of the internet than small firms (staff 10-25).

b) The local university and research institutions are the least source of technological information although large firms and those in the manufacturing sector had only slightly more access to these institutions compared to small firms and firms in the ICT sector.

c) Journals and magazines are also popular with both manufacturing and ICT firms. Again large firms use more journals that small ones.

d) The supplier is also a source of new technological information. This is more the case for firms in the ICT sector as well as large firms.

e) New technological information is also acquired from the competitor. This is more the case for the ICT sector as well as large firms.

f) Firms in the manufacturing sector and also large firms learn more of new technology from the customers than others.

g) Overseas consultants are sources of technological information for manufacturing firms and for large firms more than others.

6.11 Interactions with Local University and Research Institutions

The Science Park aims at filling a perceived void between academia and the private sector. This part of the questionnaire attempted to quantify and qualify the current interactions between the two parties and the results are given below:

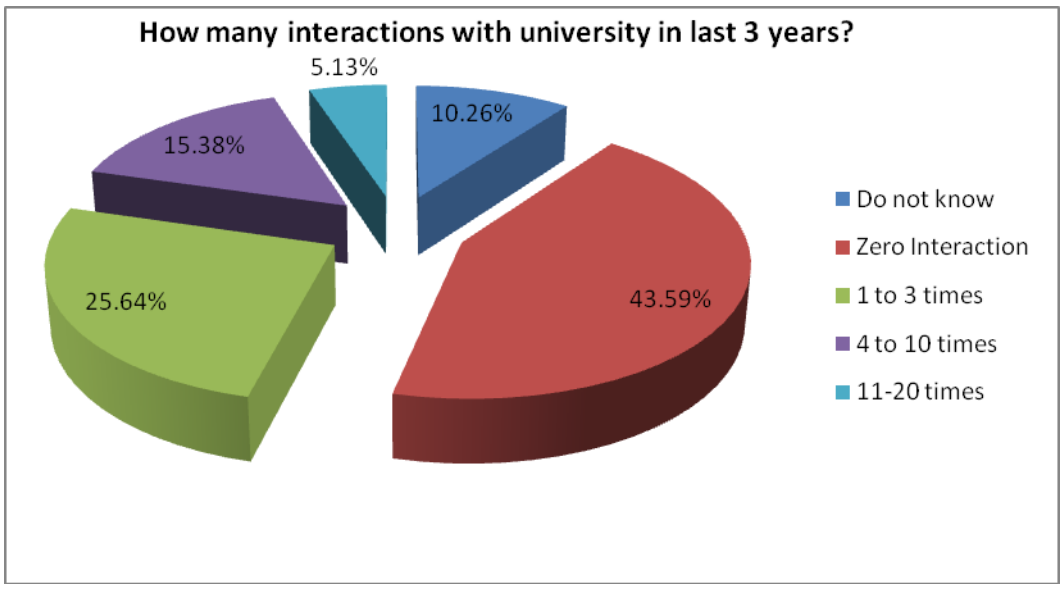

Figure 6.11 Interactions with University/Research Institutions

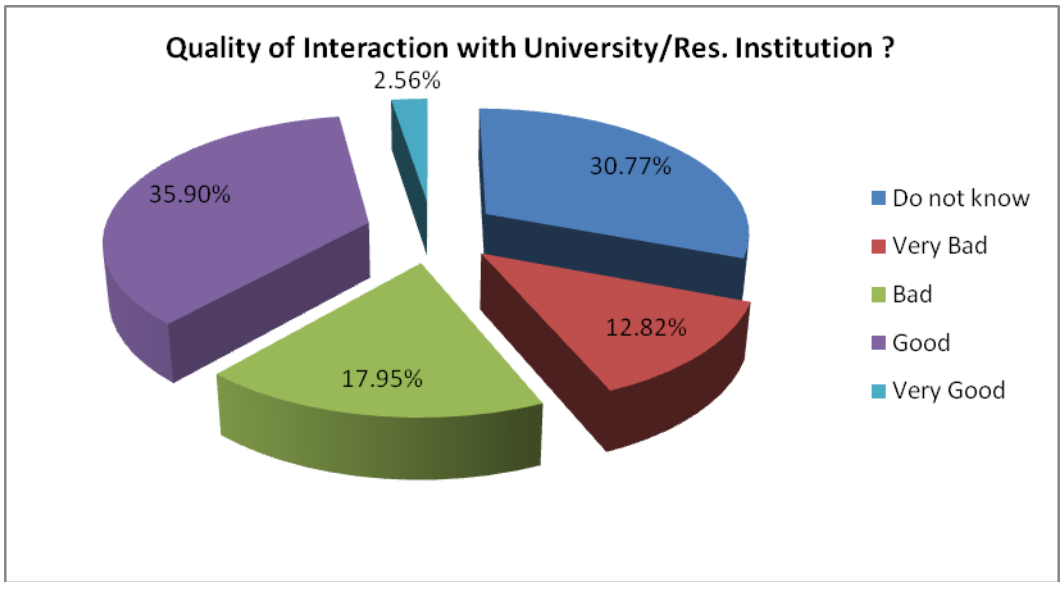

Figure 6.12 Quality of Interactions with University/Research Institutions

As can be seen, over 43% of the respondents had no interactions with the local institutions over the last 3 years. A very small percentage, 5.13% had regular (11-20 times) interactions. The interactions are judged to be good and very good by about 38%. When the data are analysed on a sector basis as well as size, these results do not alter significantly. Given the rather large number of respondents (30.77%) who did not comment on the quality of the interactions, and when only those who did respond were considered, the following satisfactory chart was obtained:

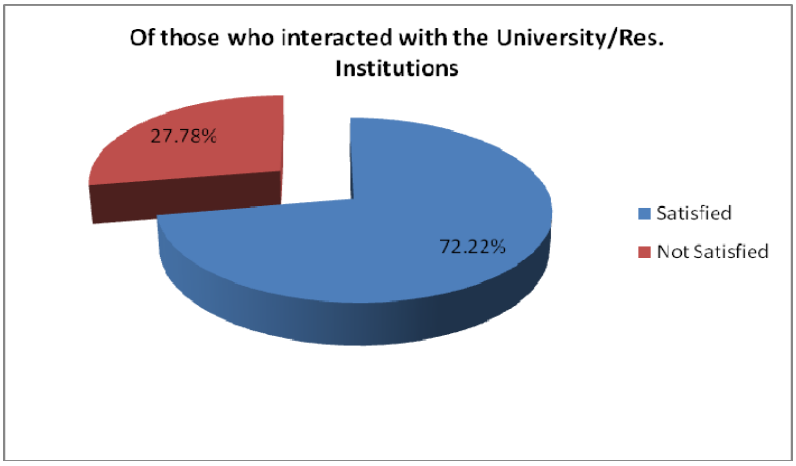

Figure 6.13 Quality of interactions

6.12 Current Sources of Ideas for New Business Creation

A potential role of the Science Park would be to assist in the development of ideas for new business creation. To that effect, the respondents were asked for their sources of new ideas and the following are the findings:

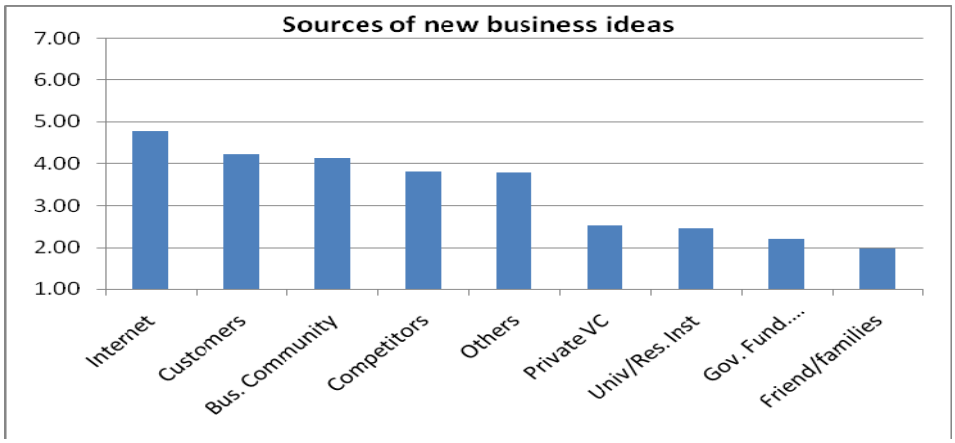

Figure 6.14 Sources of new business ideas (1=Not Important; 7 Very Important)

Once again, the internet is the most common source for new ideas. However, one also notes that the business community is also an important source. The need to develop the business networking approach to build social capital will be discussed again in a later section. The university and local research institutions were found in the bottom of the list together with Private Venture Capitalist (VC). The breakdown in terms of sectors and size of organizations are as follows:

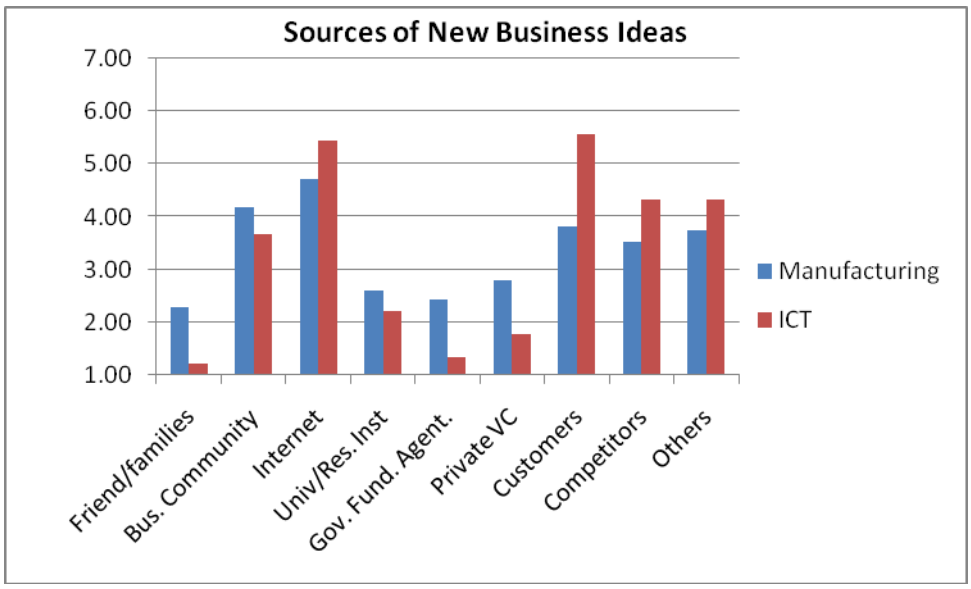

Figure 6.15 Sources of new business ideas (1=Not Important; 7 Very Important)

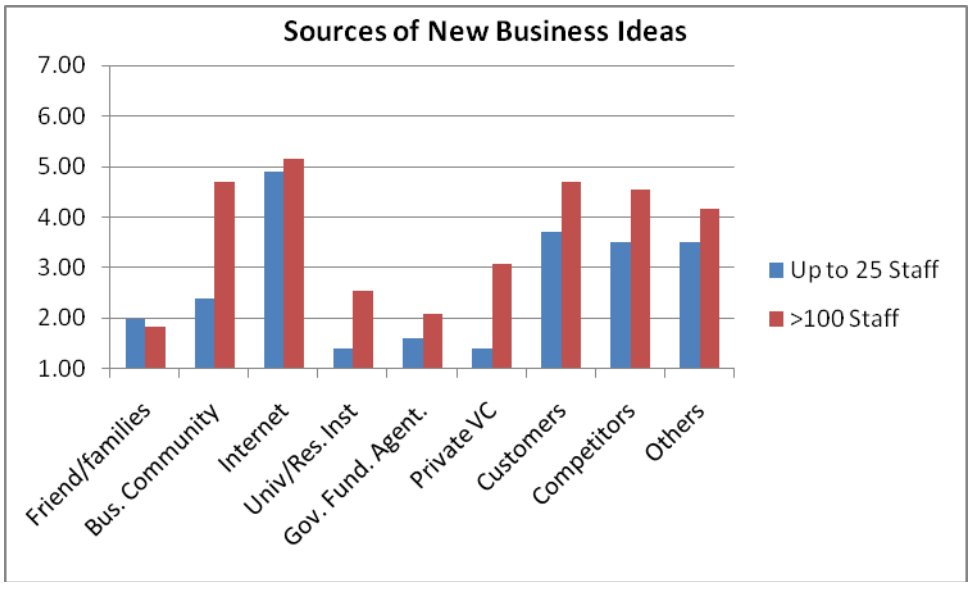

Figure 6.16 Sources of new business ideas (1=Not Important; 7 Very Important)

The following observations are made:

a) Firms in the ICT sectors as well as large firms obtain more new ideas for business from customers and competitors than other firms.

b) ICT firms rely more on the business community for new ideas than firms in the manufacturing sector.

c) Firms in the manufacturing sector obtain more ideas from venture capitalists than other firms. Likewise, large firms are more likely to approach venture capitalist than small ones.

6.13 Access to funds for the creation of new businesses

A major role of Science Parks is to facilitate access to funding of new business ideas. To that effect, this part of the questionnaire sought to determine the current main sources of funding for new enterprises in Mauritius. Below are the main findings:

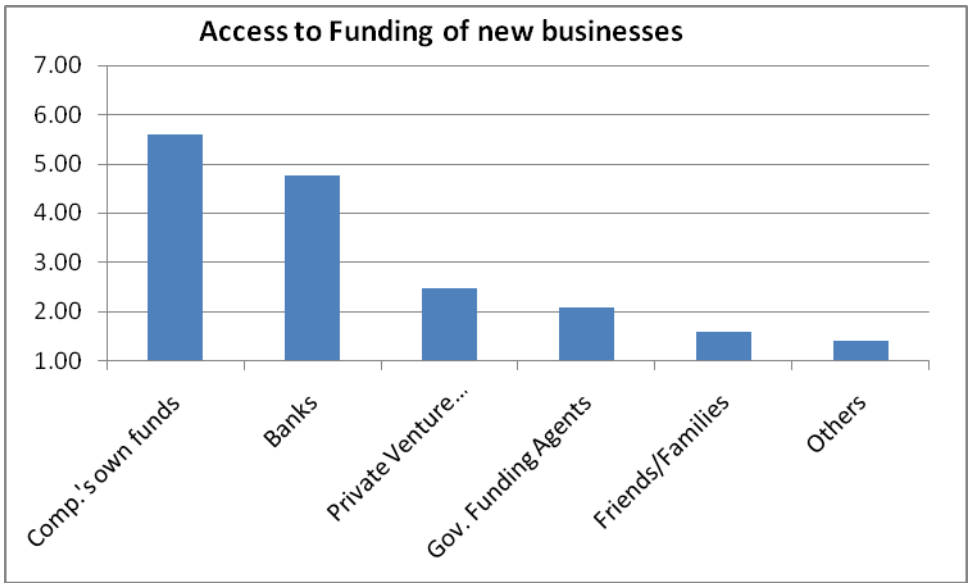

Figure 6.17 Access to funding of new businesses (1=Not Important; 7 Very Important)

As noted from above, funds for new business creation are most of the time made available from the company's own funds followed by loans from banks. Access to

Private Venture Capitalists is third in terms of priorities. When broken down to the level of sector and size of organizations, the results are as given below:

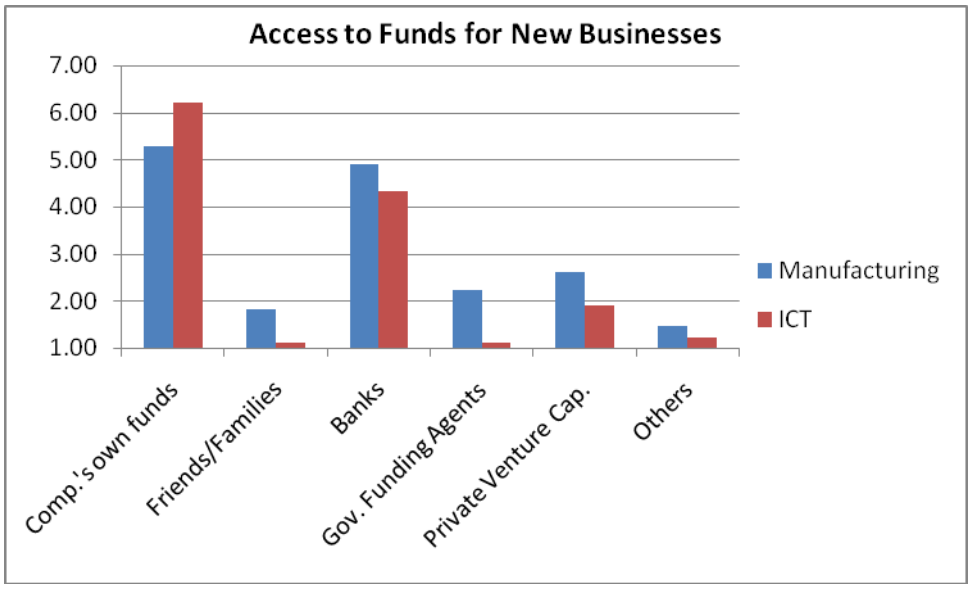

Figure 6.18 Access to funding of new businesses (1=Not Important; 7 Very Important)

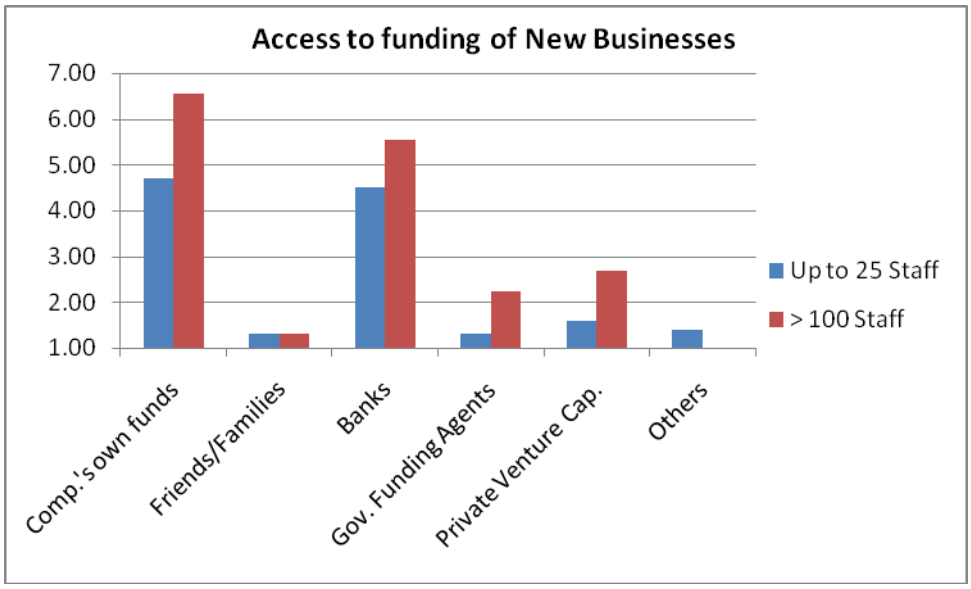

Figure 6.19 Access to funding of new businesses (1=Not Important; 7 Very Important)

The following observations can be made:

a) A primary source of funding of new businesses is from the company itself or the promoter's own capital.

b) Banks are the second most important source followed by Private Venture Capitalists.

c) Private Venture Capitalists are mostly approached by manufacturing firms and by large firms than by others.

d) Government funding agencies are mostly approached by manufacturing firms and large firms than by others.

6.14 Management Assistance

Incubating firms require substantial assistance in the early phases of development. This ranges from business planning, marketing strategy or even the day-to-day management of the firm. This part of the questionnaire examined the ways in which the enterprises currently have access to these types of management expertise. The findings are as follows:

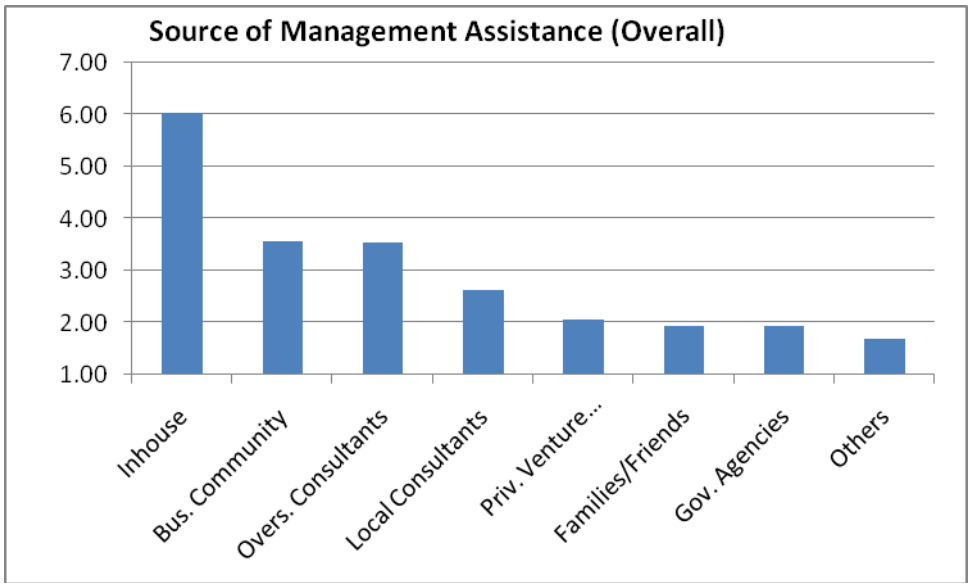

Figure 6.20 Sources of Management Assistance (1=Not Important; 7 Very Important)

Most firms seek management expertise in-house, followed from the business community. Both overseas and local consultants are made use of and local government agencies are seen to be not as important a source of management assistance. When broken down to the level of sectors and size of firms, the results are shown below:

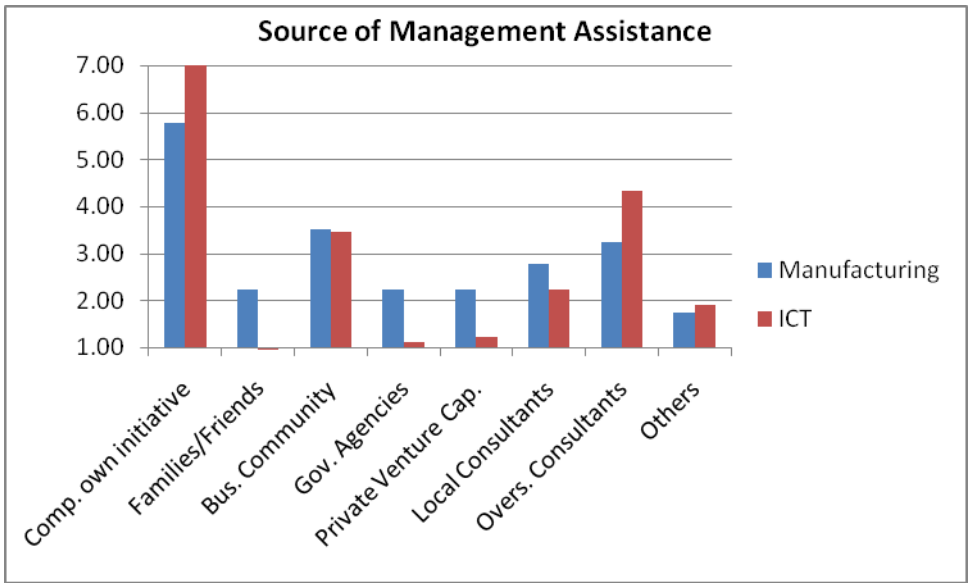

Figure 6.21 Sources of Management Assistance (1=Not Important; 7 Very Important)

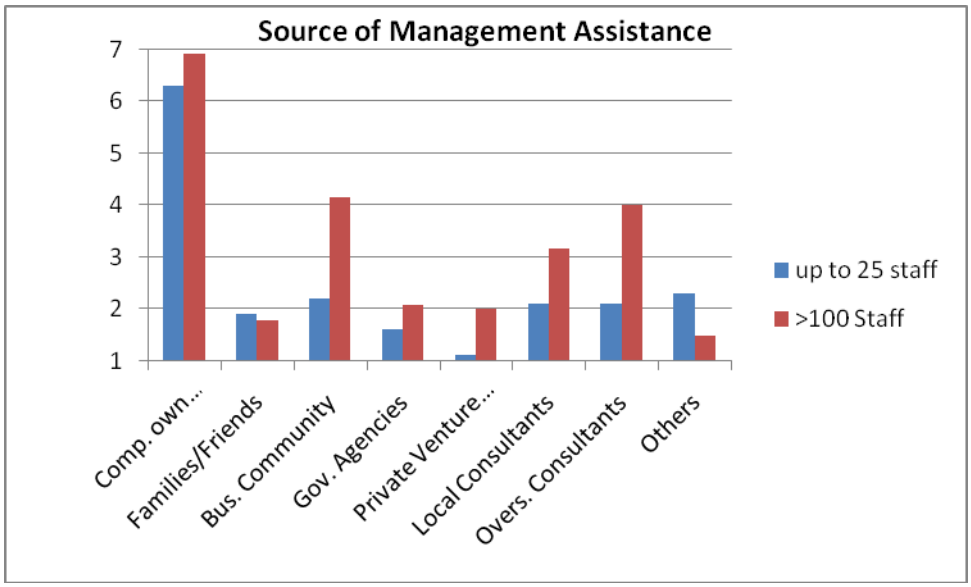

Figure 6.22 Sources of Management Assistance (1=Not Important; 7 Very Important)

The following observations are made:

a) Local consultants are preferred by a greater percentage of manufacturing firms.
b) Overseas consultants are used more by a greater percentage of ICT firms.
c) A greater percentage of large organization uses consultants compared to small firms.
d) Manufacturing firms make more use of Government agencies and Venture Capitalists than ICT firms.
e) Large organizations seek management assistance from the business community more than the small ones.

6.15 Constraints to Creating New High-Tech Businesses

This section of the questionnaire prompted the respondents to prioritize what they perceived to be the constraints in the creation of new high-tech businesses within the context of Mauritius. These constraints comprised all aspects of business including access to capital, market, management, infrastructure, networking and quality of human resources. The results are summarized below:

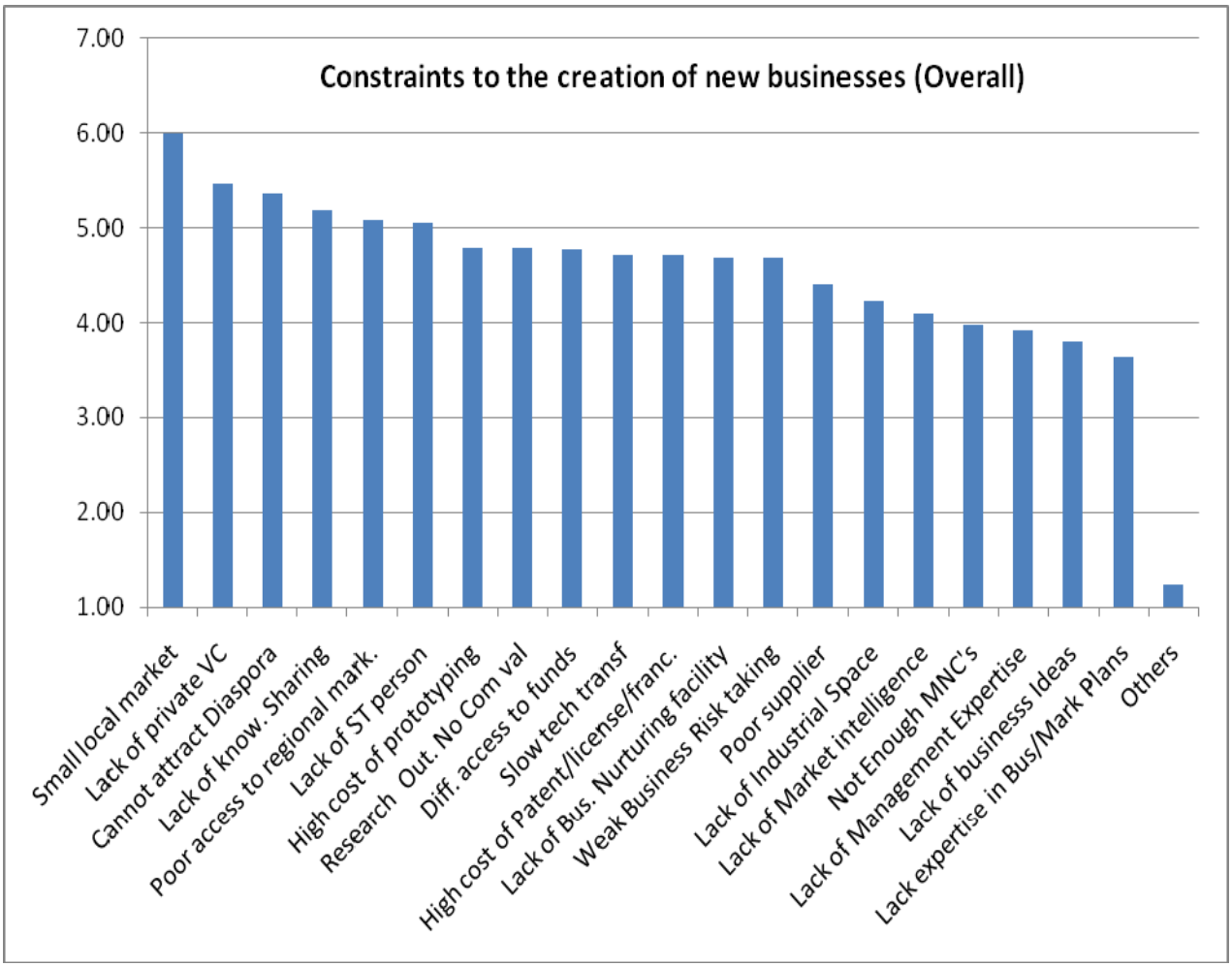

Figure 6.23 Constraints to new business creation (1= Strongly Agree; 7= Strongly Disagree)

6.15.1 Statistical Significance

As can be seen from figure 6.23, some of the mean values are similar. In order to demarcate those which are statistically significant, the hypothesis test for the difference in means is used. Table 6.3 and Table 6.4 show the results of typical tests undertaken. For example, the difference of means test for 'small local market' and 'slow tech. Transfer', as shown in Table 6.3, indicates that the difference is statistically significant. On the other hand, as shown in Table 6.4, the difference of the means test of 'Lack of S&T Personnel' and 'Weak Business Risk Taking' is statistically insignificant. In such cases, the identified constraints can be taken to be

of equal importance. It turns out that the 5 top constraints of figure 6.23 are the major ones and these are discussed further in a later section.

	Small local market	Slow tech transf
Sample Summaries	**Data Set #1**	**Data Set #1**
Sample Size	40	40
Sample Mean	6.000	4.718
Sample Std Dev	1.601	1.907
Hypothesis Test (Difference of Means)	**Equal Variances**	**Unequal Variances**
Hypothesized Mean Difference	0	0
Alternative Hypothesis	<> 0	<> 0
Sample Mean Difference	1.282	1.282
Standard Error of Difference	0.393779709	0.393779709
Degrees of Freedom	78	75
t-Test Statistic	3.2558	3.2558
p-Value	0.0017	0.0017
Null Hypoth. at 10% Significance	Reject	Reject
Null Hypoth. at 5% Significance	Reject	Reject
Null Hypoth. at 1% Significance	Reject	Reject

Table 6.3 Hypothesis Test - Difference of means test; H_o rejected

	Lack of ST person	Business Risk taking
Sample Summaries	**Data Set #1**	**Data Set #1**
Sample Size	40	40
Sample Mean	5.051	4.692
Sample Std Dev	1.880	2.150
Hypothesis Test (Difference of Means)	**Equal Variances**	**Unequal Variances**
Hypothesized Mean Difference	0	0
Alternative Hypothesis	<> 0	<> 0
Sample Mean Difference	0.359	0.359
Standard Error of Difference	0.451638845	0.451638845
Degrees of Freedom	78	76
t-Test Statistic	0.7948	0.7948
p-Value	0.4291	0.4292
Null Hypoth. at 10% Significance	Don't Reject	Don't Reject
Null Hypoth. at 5% Significance	Don't Reject	Don't Reject
Null Hypoth. at 1% Significance	Don't Reject	Don't Reject

Table 6.4 Hypothesis Test - Difference of means test; H_o Not rejected

6.15.2 Constraints by categories of firms

When broken down to the level of sector and sizes of the organizations, the following emerges:

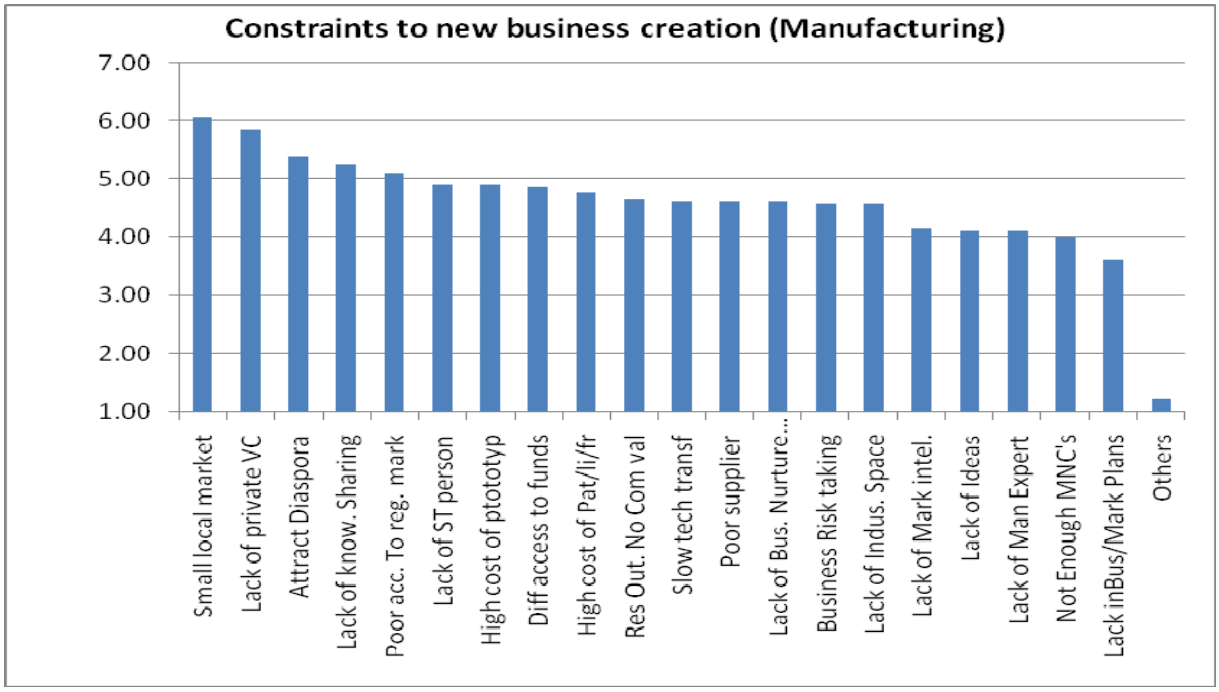

Figure 6.24 Constraints to new business creation (1= Strongly Agree; 7= Strongly Disagree)

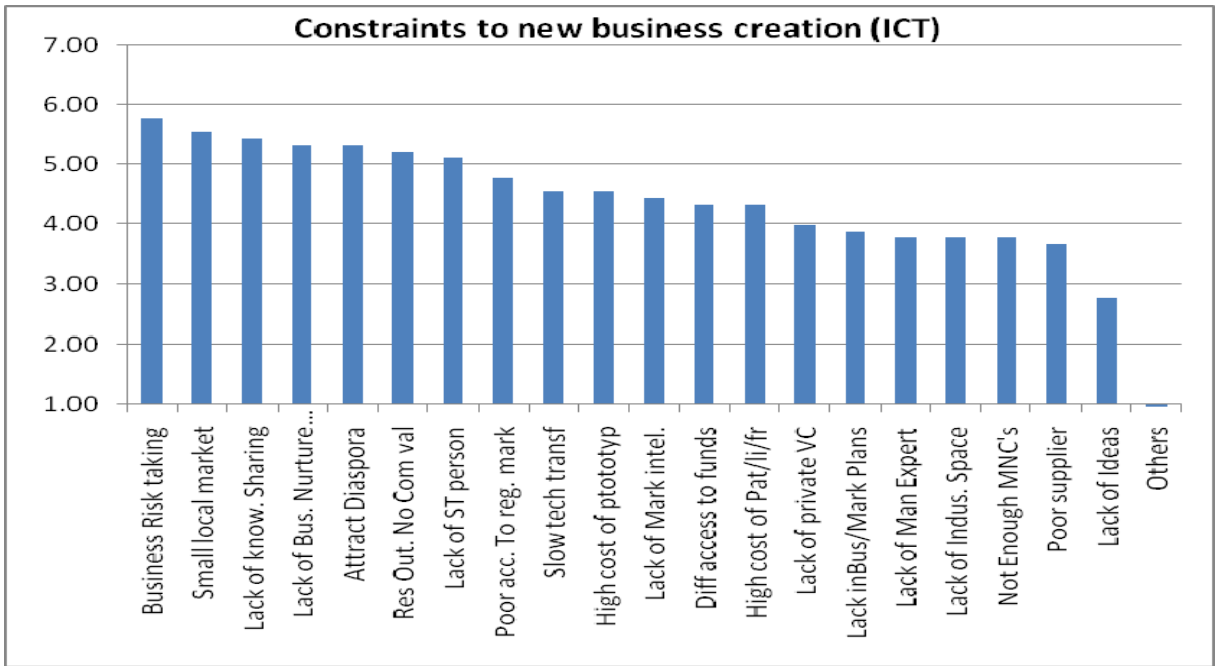

Figure 6.25 Constraints to new business creation (1= Strongly Agree; 7= Strongly Disagree)

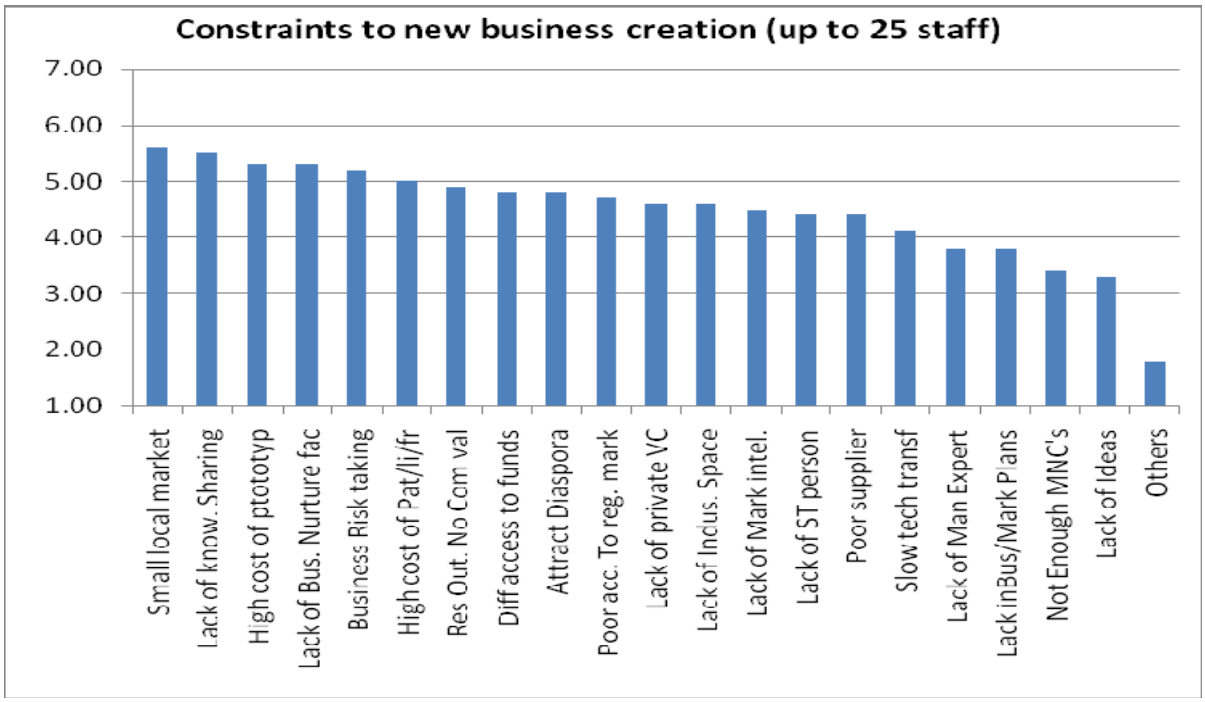

Figure 6.26 Constraints to new business creation (1= Strongly Agree; 7= Strongly Disagree)

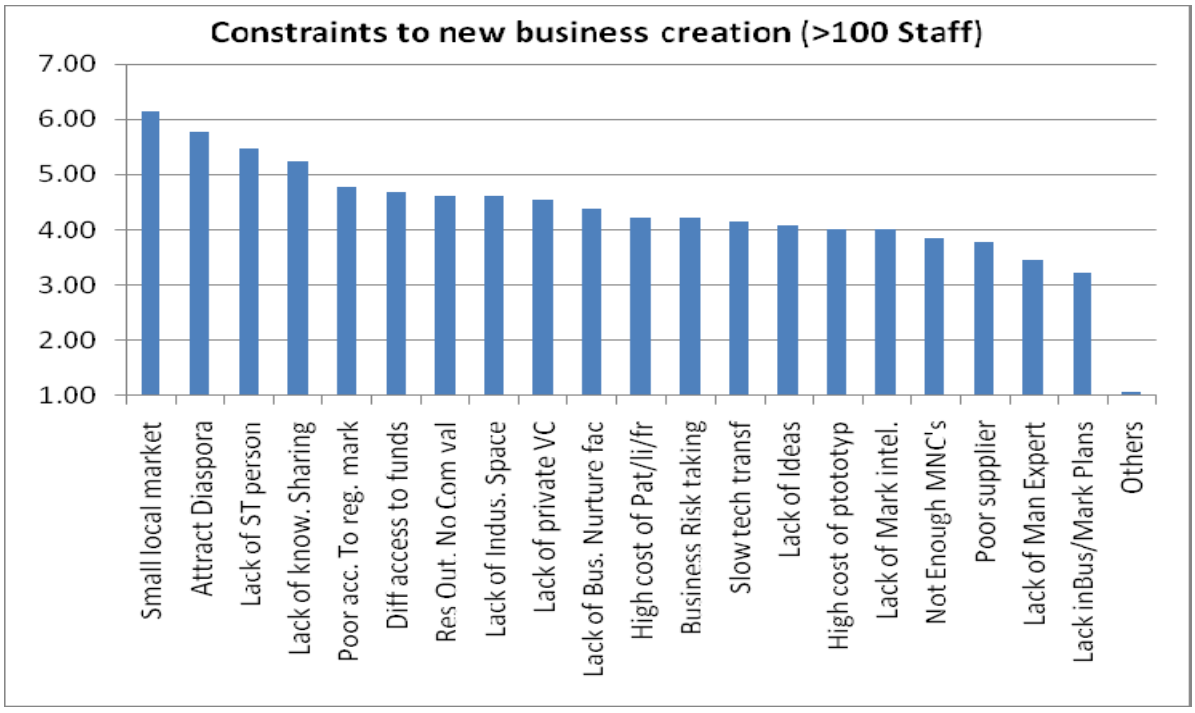

Figure 6.27 Constraints to new business creation (1= Strongly Agree; 7= Strongly Disagree)

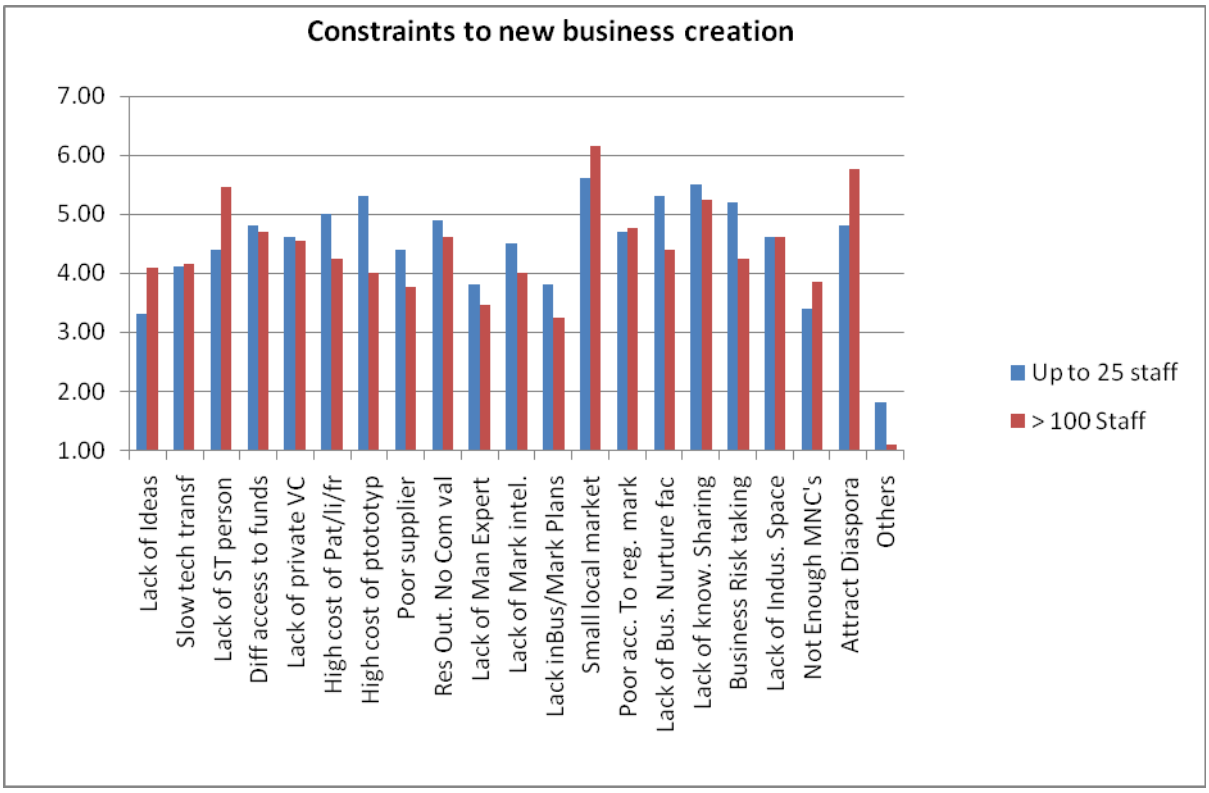

Figure 6.28 Constraints to new business creation (1= Strongly Agree; 7= Strongly Disagree)

6.15.3 Five most important constraints

The chart below summarises the findings for the four categories of firms and this is followed by some observations.

	Manufacturing	ICT	Up to 25 Staff	> 100 Staff
1	Small size of local market	Lack of Business Risk taking culture	Small size of local market	Small size of local market
2	Lack of private Venture Capital	Small size of local market	Lack of knowledge Sharing among firms	Unable to Attract Diaspora
3	Unable to Attract Diaspora	Lack of knowledge Sharing among firms	High cost of prototyping	Lack of ST person
4	Lack of knowledge Sharing among firms	Lack of Business Nurturing facilities	Lack of Business Nurturing facilities	Lack of knowledge Sharing among firms
5	Poor access to Regional Market	Unable to Attract Diaspora	Lack of Business Risk taking culture	Poor access to Regional Market

Table 6.5 Five most important constraints in creating new businesses by categories of respondents

Observations:

a) Only very few of the listed constraints scored less than four thus indicating that most were of concern although some were more pressing than others.
b) All categories agreed that the small size of the local market was the major constraint.
c) All categories agreed that lack of knowledge sharing among firms was a major constraint to new business creation.
d) All categories except small firms agreed that the inability of Mauritius to attract its Diasporas was a major constraint.
e) Lack of a 'business risk taking culture' was felt a priority by ICT firms and small firms in general. Although a concern, this was not a top priority for large firms and firms in the manufacturing sector.
f) The need for 'business nurturing facilities' was a priority concern for firms in the ICT sector and for small firms.
g) Although a concern to all, only large firms felt that lack of S&T personnel was a priority.
h) Although a concern to all, only firms in the manufacturing sector felt that lack of venture capital was a priority.
i) Although a concern to all, only small firms felt that high cost of prototyping was a priority.

6.16 Services to be provided by the Science Park

Having compiled the various aspects of the current business environment within which firms are operating and new businesses are created, the last part of the questionnaire prompted the respondents for the type of services that they anticipate a Science Park to deliver in order to meet their requirements for business

development and growth. These services range from access to capital, management expertise, infrastructural and communication support and marketing needs. In addition, the nature of governance of the Science Park as well as its financing mode that would most suit the respondents was sought. The findings are displayed in figures 6.29 and 6.30.

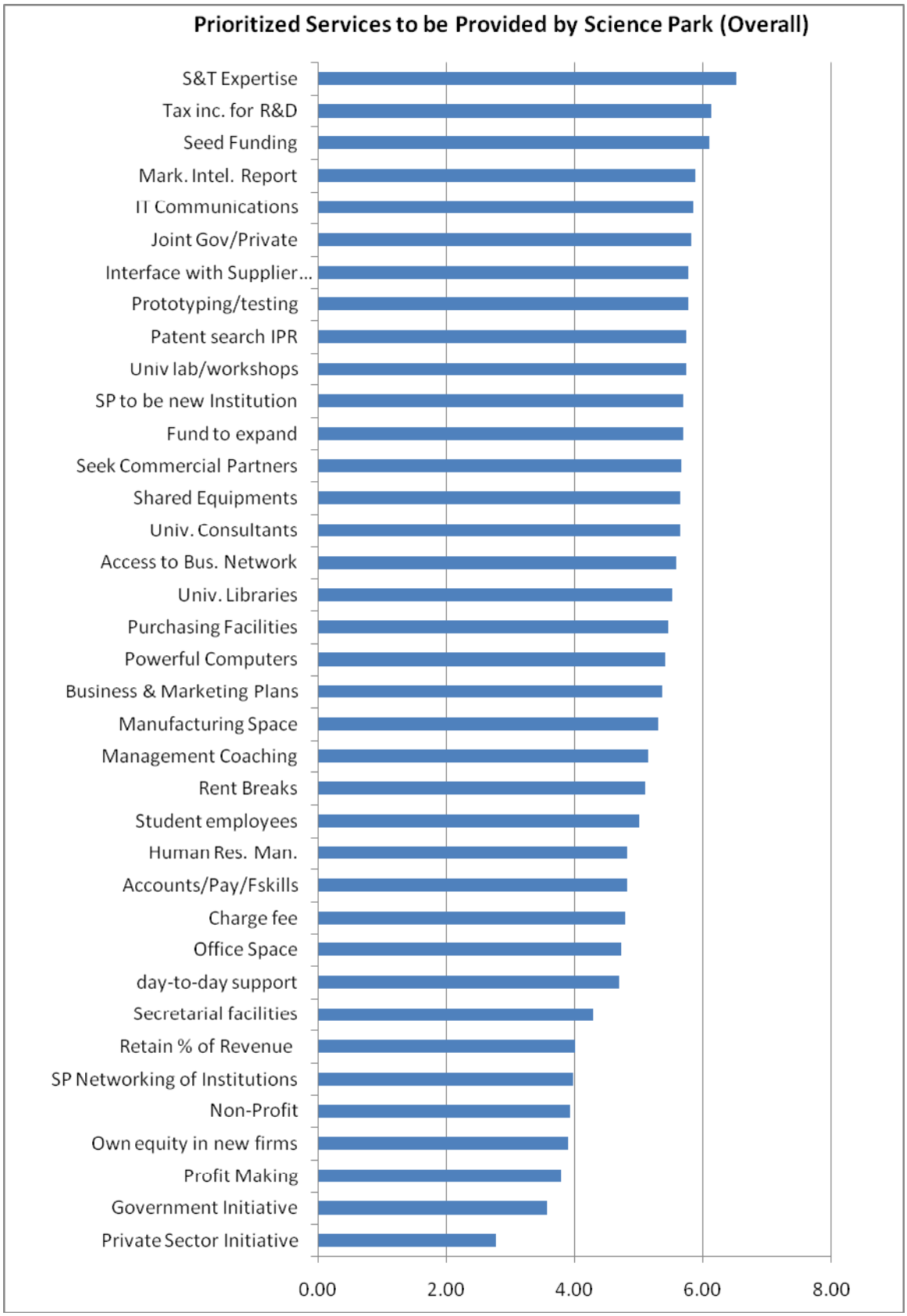

Figure 6.29 Prioritized services to be provided by Science Park(1= Not Important at all; 7= Very Important)

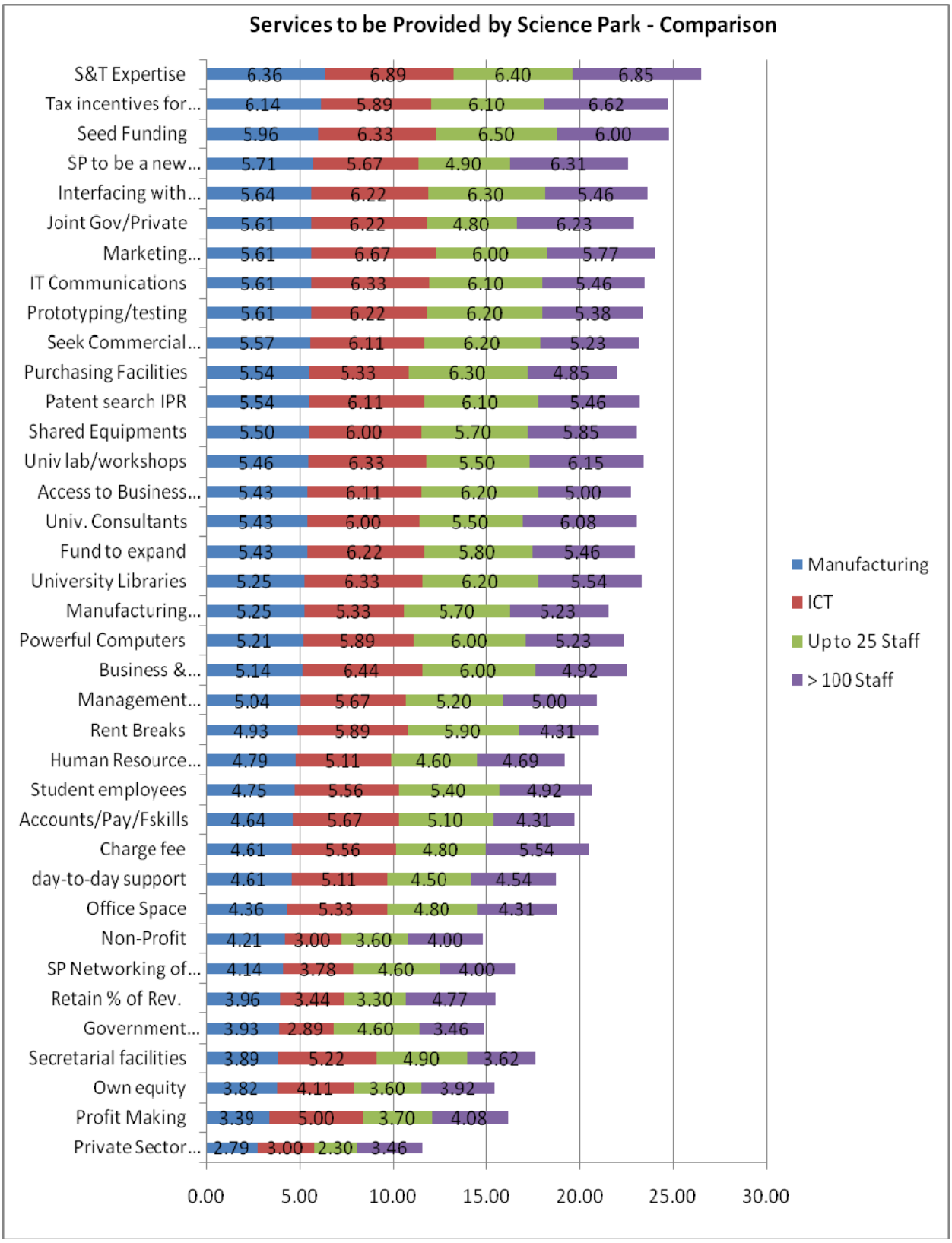

Figure 6.30 Services to be provided by Science Park by categories of firms (1=Not Important at all; 7= Very Important)

6.16.1 Priority Services

In practice, a Science Park might not, at least initially, provide all the services. To that effect, these are broken down into the categories of '*First 10 priorities'*, '*Nice to have'*, and '*last ten priorities*', as shown below in figures 6.31 to 6.33.

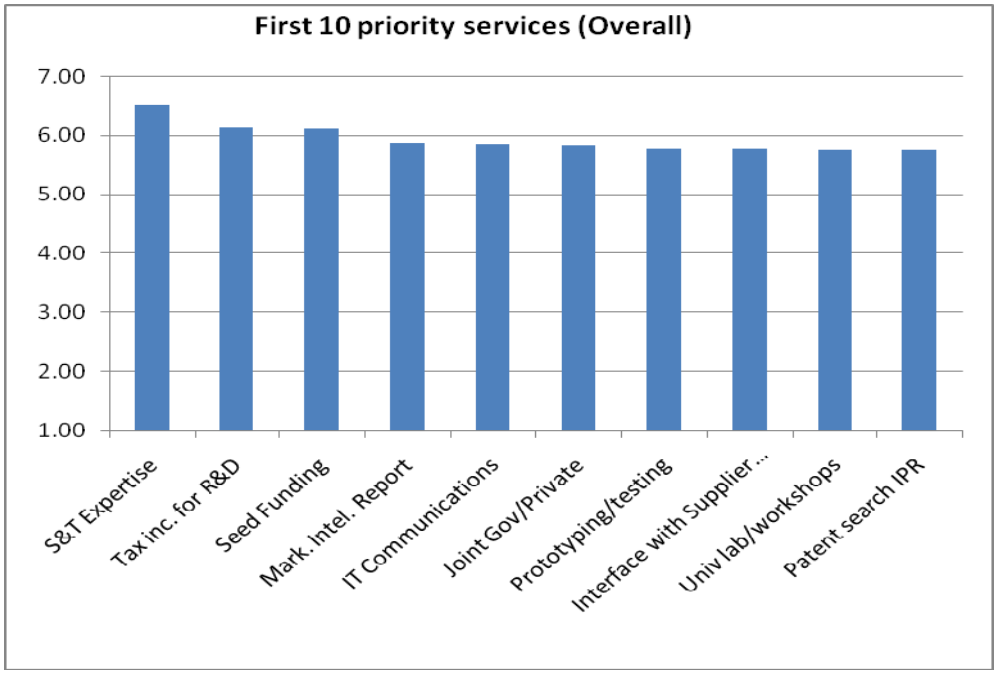

Figure 6.31 First 10 Priority Services (1=Not Important at all; 7 = Very Important)

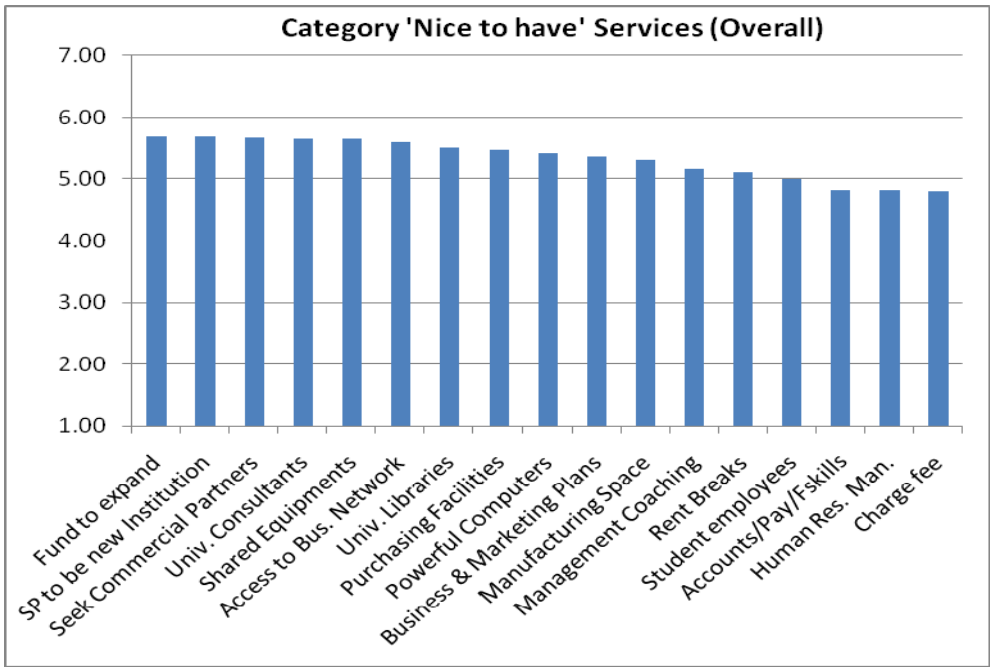

Figure 6.32 Priority Services (1=Not Important at all; 7 = Very Important)

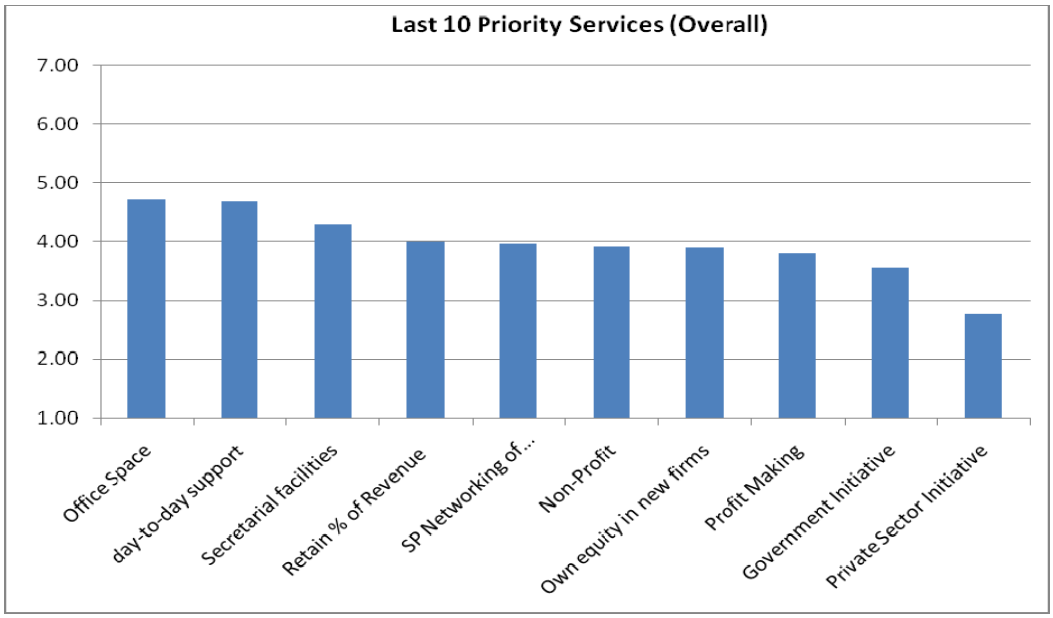

Figure 6.33 Priority Services (1=Not Important at all; 7 = Very Important)

It is worthy to comment on the last 10 priorities as these reveal aspects which are peculiar to the Mauritian context. As can be seen from figure 6.33, the respondents did not emphasize on the need for Office Space, Day-to-Day management and Secretarial facilities. This likely because there already exists 'industrial spaces' where enterprises can be located. The coming section on Governance will discuss the other '*low priorities*' items in figure 6.33.

6.16.2 Matrix of Priority Services

The above findings can be summarized in a 'Matrix of Priorities Services', such that the priorities of each category of firms can be compared, as shown in Table 6.6, below.

	Manufacturing	ICT	Up to 25 Staff	>100 Staff
1	S&T Expertise	S&T Expertise	Seed Funding	S&T Expertise
2	Tax incentives for R&D by firms	Marketing Intelligence Report	S&T Expertise	Tax incentives for R&D by firms
4	Seed Funding	Business & Marketing Plans	Purchasing Facilities	Science Park to be a new Institution
5	Science Park to be a new Institution	Seed Funding	Interfacing with Supplier Industries	Joint Gov/Private Initiative
6	Interfacing with Supplier Industries	Access to University lab/workshops	Prototyping/testing	Access to University lab/workshops
7	Prototyping/testing	Facilities for IT Communications	Access to University Libraries	University Consultants
8	Facilities for IT Communications	Access to University Libraries	Access to Business Network	Seed Funding
9	Marketing Intelligence Report	Fund to expand	Seek Commercial Partners	Shared Equipments
10	Joint Gov/Private Initiative	Prototyping/testing	Facilities for IT Communications	Marketing Intelligence Report

Table 6.6 Matrix of Priority Services Required by Categories of Firms

The above table uses a colour coding to identify common needs such that the services of the Science Park can be 'tailor-made' to meet the firm's requirements. A major decision would be whether to design a Science Park for a specific category of

firms, such as for the ICT sector only, or a ‘general purpose’ Science Park to host both sectors. The next section addresses this issue.

6.16.3 Statistical Evidence for a ‘General Purpose’ Science Park

In order to determine whether the Science Park should cater for only a specific category of firms such as Manufacturing or ICT, the Spearman’s Rank Coefficient is used to determine the degree of association between the responses to the services to be provided by the Park obtained from the different categories of firms. Using SPSS, the results are shown in Table 6.7.

			Manufacturing	ICT	upto25staff	more100staff
Spearman's rho	Manufacturing	Correlation Coefficient	1.000	.846(**)	.851(**)	.896(**)
		Sig. (2-tailed)	.	.000	.000	.000
		N	41	41	41	41
	ICT	Correlation Coefficient	.846(**)	1.000	.845(**)	.822(**)
		Sig. (2-tailed)	.000	.	.000	.000
		N	41	41	41	41
	upto25staff	Correlation Coefficient	.851(**)	.845(**)	1.000	.691(**)
		Sig. (2-tailed)	.000	.000	.	.000
		N	41	41	41	41
	more100staff	Correlation Coefficient	.896(**)	.822(**)	.691(**)	1.000
		Sig. (2-tailed)	.000	.000	.000	.
		N	41	41	41	41

** Correlation is significant at the 0.01 level (2-tailed).

Table 6.7 Output for Spearman’s Rank Coefficients for responses by categories

As noted above, the Spearman's Rank Coefficients are significantly close to 1 in most of the cases, and this suggests a high degree of association among the responses with regard to the services to be provided by the Park. On the basis of these results, it can be assumed that there is statistical significance in that the firms require similar services and therefore it is recommended that the Science Park be a 'General Purpose' one catering for all the categories discussed, namely, Manufacturing, ICT, Small and Large firms.

6.17 Governance, Structure and Mode of Financing

An important aspect of the Science Park pertains to its governance, its structural form and its financial sustainability. From figure 6.31, of the top 10 priorities, it is clear that the initiative to set up the Park must be a joint Government/Private Sector one. Conversely, from figure 6.33**,** of the 10 least priorities, the respondents do not wish the initiative to be solely Government driven or solely Private sector driven. Thus the desired governance and management of the Science Park is to be a joint effort.

With regard to the structure of the Science Park, most respondent wish it to be a new institution rather than a networking of existing institutions. However, this new institution is to provide S&T expertise and knowhow and not necessarily manufacturing space and day-to-day management facilities, as other Science Parks, say in Singapore (Koh et al., 2005), or Malaysia (Ramasamy et al,. 2004). An important requirement in the structural form is access to university infrastructure such as laboratories, workshops, libraries as well as academic consultancies. Therefore, a formal linkage with the university is strongly desirable in the structural form of the Science Park. This arrangement will also complete the '*triple helix*' format of government, private sector and academia.

With regard to the financing of the Science Park, the respondents do not wish the Science Park to be an entirely for-profit organization. On the other hand, they agreed that it should charge a fee for its services. However, as can be seen from figure 6.33, the respondents are against the Science Park retaining a percentage of the revenue from the new businesses that may be created and nurtured by the Park. Likewise, the proposal of the Science Park owning equity a share in the new business is not appealing to the respondents (figure 6.33). These findings are different to the practice in many Science Parks such as those in the US, Europe and the Nordic countries (Lofsten & Lindelof, 2003).

6.18 Conclusion

This chapter covered extensively the objectives, design and implementation of a quantitative survey of enterprises through the use of e-mails. Statistical analysis of the data enabled a description the business environment in which enterprises operated in the sector of manufacturing and ICT. In particular, the factors inhibiting the creation of new high-tech enterprises were identified and prioritized. The responses of the survey also led to the formulation of a set of desired services that could be provided by a Science Park in order to promote the growth and development of new high-tech businesses. It was found that the requirements of the firms were different according to the sectors of operation and the sizes of the firms. Based on these findings a '*matrix of prioritized services'* was devised that could assist in determining the needs of specific category of enterprises. In addition, the findings indicated that the preferred mode of functioning for the Science Park is that of a joint Government/Private sector initiative with close collaboration with academia. It was suggested that the Science Park could charge a fee for its services although it should not be entirely profit focus and thus also be for 'public good'. The idea that the

Science Park could own equity or retain a small percentage of revenue from newly created business was not retained by most respondents. The next chapter summarizes all the findings of this study and areas for future research are identified.

Chapter 7: Summary & Conclusion

7.0 Contributions of Present work

This study set out to define the roles and functions of a Science Park to be operated in the small developing island state of Mauritius. The literature on the subject of Science Park including incubators, although rich, is not comprehensive as it contains a number of gaps which are difficult to fill due to the varying nature and purposes of Science Parks across the world. In particular, this makes it difficult to identify best practices that can be adopted by countries wishing to introduce Science Parks to consolidate their innovation systems. A major drawback, as identified by the secondary data analysis, is the absence of a frame work within which the performance of a Science Park can be assessed. In the same vein, there is the absence of an established framework which can be used to determine the appropriate services that a Science Park ought to deliver in order to meet the requirements of its stake holders which include the government, academia and private enterprises.

The present study addressed the literature gaps and attempted to contribute to new knowledge by:

i. Presenting a theoretical framework to assess the impact of a Science Park on the competitiveness of a region or country.
ii. Defining the roles and functions of a Science Park in a small island state.
iii. Introducing a methodological approach to the undertaking of a feasibility study for the setting up of a Science Park.

7.1 Use of Porter's Diamond model for Competitiveness

The present work made extensive use of Porter's diamond model to situate and contextualize the setting up of a Science Park with the objective of enhancing global competitiveness through technological development. The methodology adopted was based on the analysis of the strengths and weaknesses of the various variables making up the determinants of the model of Porter through comparisons with other similar countries. In particular, by introducing a Science Park as a specialised factor condition into the Porter's model, the subsequent impact on the determinants of the model could be assessed. In this way, by examining the affected variables of the determinants, a series of 10 core questions pertaining to the potential roles of a Science Park were derived. These questions later formed the basis of a qualitative survey to determine the roles of the Science Park.

7.2 Enabling Factors & Roles of the Science Park

The qualitative survey, through in-depth interviews of key decision makers on the island, led to the formulation of a set of roles for the Science Park. However, a major finding of the study was that the setting up of the Science Park first required the presence of certain enabling factors; the main ones of which are listed below:

1) A liberalized IPR policy.
2) Avoid duplication of existing facilities.
3) Start small in terms of infrastructure for the Science Park.
4) Good leadership and marketing of the Science Park.
5) Branding and high norms and standards for products from the park.
6) Focus on projects for sustainable development.

Within the ambit of the above enabling factors, the roles of the Science Park were then perceived to be the following:

1) Promote entrepreneurship.
2) Promote interest in science (education).
3) Create science job opportunities.
4) Develop sustainable resources.
5) Improve quality of research institutions.
6) Attract Multi National Companies.
7) Attract venture capitalists.
8) Improve quality of suppliers
9) Enhance exportation

The study also showed that all of the above roles were possible because the prime causality of the Science Park was to enhance the technology absorption of the country. The framework used to derive the roles of the Science Park could equally be used to evaluate the performance of the Park as the framework was built upon variables which determined the characteristics and hence the performance of the Park.

7.3 Prioritized Functions & Services of the Science Park

The use of the findings from both the qualitative and quantitative surveys allowed the formulation of a set of about 40 services which were deemed necessary by the enterprises in Mauritius. The 10 most important functions and services were:

1) Provide Scientific & Technological expertise.
2) Provide tax incentives to promote R&D in the private sector.
3) Provide access to seed funding in establishing new high tech enterprises.
4) Prepare market intelligence report.

5) Provide ICT support.
6) Science Park to be a joint Government/Private sector initiative.
7) Provide access to testing and prototyping facilities.
8) Facilitate interfacing with suppliers.
9) Access to university laboratories/workshops/databases.
10) Assistance in patent search.

With regard to the governance of the park, it was clear that a joint government and private sector initiative was preferred by most. In the same vein, the Science Park should not be a for-profit driven organization but be seen also as a ‘public good’ for the technological development of the economy. Its structure was to be kept simple, perhaps, involving a networking of existing institutions. Facilities for manufacturing space just like secretarial services were not seen to be very important. However, a strong linkage of the Science Park to the local university was rated very highly, although physical proximity was not necessary, given the smallness of the island.

A major finding was that there was statistical evidence that the Science Park should be a ‘General Purpose’ Park catering for small and large enterprises in both the manufacturing and the ICT sectors. This is in contrast to the many ‘industry specific’ parks that have been created in several countries. This finding could be a reflection of the uniqueness of a small island developing state whereby close proximity can also breads sharing of know-how and social capital enhancement, both of which are important ingredients for the promotion of entrepreneurship.

7.4 Conclusions

The methodological approach adopted in the present work can be used for other studies which analyse the impact of introducing a new institution within the framework of competitiveness enhancement. The strategy involved both qualitative and quantitative analyses as well as a top-down and bottom-up approach. This ensured that the views of all major stakeholders were taken on board while findings from the extant literature were also used as guiding variables to ensure completeness and avoiding common pitfalls. The methodology employed is thus suited for feasibility studies and potential impact assessment.

7.5 Future work

A major outcome of this work is the requirement for the Science Park to operate within an existing set up of research and related institutions, without duplication of activities. This may call the Science Park to operate within a networking approach whereby resources from various institutions are pooled together in order to avoid duplication and improve relevancy and cost-effectiveness of the services to be provided for new high-tech business creation. This networking approach will require careful arrangements both in terms of resource planning and the deployment of human capital. It will necessitate analysis involving resource theory, agency theory and institutional theory (Wright et al., 2006) which could form the basis of future research on the subject.

Finally, the present work is a feasibility study carried out before the setting up of the Park. No doubt when the Park is operational, a post-operation study should be carried out to assess whether the roles and functions are indeed as elaborated in this study.

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Appendix One

Formulation of 10 core questions from the application of Porter's Diamond model for competitiveness

The application of the theoretical framework of the Porter's model in Chapter 4 revealed a number of sectors and measures which Mauritius has to address in order to improve its competitiveness and to make the transition from an efficiency-driven economy to that of innovation-driven. One of the sectors where Mauritius has to focus upon is the enhancement of its advanced factors and the creation of new specialized factors. It is against this background that the proposal for the creation of a Science Park is being put forward. The following section describes how the main variables which describe the four determinants of the Porter's model will be affected by the creation of a Science Park. Based on these, a set of core questions are then formulated with regard to the potential role of a Science Park in enhancing the competitiveness of the Mauritian economy.

I. Variable: Availability of scientists and engineers (See Fig. 4.10, 4.11)

It is vital for Mauritius to increase its pool of scientists and engineers. Among the four countries compared, Mauritius lags behind in the availability of scientific human resources. This is of serious concern which directly impacts negatively on the competitiveness of the nation as well as on its ability to transit from an efficiency-driven economy to an innovation-driven one. The work of Seyoum (2004) demonstrated a very strong correlation between a nation's performance in high-tech export with the availability of scientists and engineers. Chou et al. (2008) argue that "*human resources for science and technology are*

crucial for the survival and growth of a nation's technology". The same authors also developed an indicator based on youth's interest in science in order to quantify a nation's technological competitiveness. In Mauritius, it has been shown that interest in scientific subjects is on the decline as more students, particularly female students, are attracted to the "softer" subjects (MRC, 2005). One of the reasons for dropping science subjects at an early stage is because of the perceived limited science-related job opportunities available on the local market (MRC, 2005). In addition, there are a significant number of Mauritian scientists working abroad, although no official figures are available. It can be argued that the setting up of a Science Park can act as a "pull-factor" to attract more students to science and engineering. This leads to

Question One:

Qu_1: Will the setting up of a Science Park in Mauritius attract more students to undertake science and engineering subjects?

II. Variable: Technology Readiness/Absorption (See Fig.4.12)

Compared to Singapore and Malaysia, Mauritius is lacking in its technology readiness and its ability to absorb technology. Both at the level of domestic and commercial uses of technology, Mauritius is third in the list of four, only doing slightly better than Botswana. The ability to absorb technology is an important requirement as described by Roessner et al. (1996). They postulate that industrialized nations must be able to acquire indigenous capacity to create, manufacture and market new technology through absorption of new technology from abroad and adaptation to local conditions. Koh et al.(2005) describe

that one of the reason to creating Science Parks is to attract multinational corporations which can transfer their technological know-how. The same authors attribute Singapore's success mainly due to inbound Foreign Direct Investment (FDI) by multinational enterprises; "*the inbound FDI brings foreign capital and technology*". Seo (2006) also describes how Science Parks in Korea were created with a view to attracting FDI and "*higher value-added activities*". However, the technological readiness of a nation will no-doubt depends on the quality of its human resources and particularly the level of technological literacy of the people. From this discussion, one postulates **Question Two:**

Qu_2: Will the setting up of a Science Park in Mauritius improve the technology absorption capacity of the country?

III. Variable: Quality of the research institutions (See Fig. 4.13)

The quality of the research institutions in Mauritius is low compared to that of Singapore and Malaysia. The island of Mauritius has two main universities where the focus has been on teaching rather than on research. Since its creation in 1965, the University of Mauritius has yet to produce a patent. Research has been mostly of academic nature focusing on basic research rather than applied. In spite of the fact that some Science Parks, such as the Cambridge Science Park, focus on basic research rather than applied research such as in Singapore and Korea (Seo, 2006), it is felt that a Science Park operating in Mauritius should model those of Singapore and Korea and thus promote applied research. Currently, in Mauritius, there exist a number of institutions

(Mauritius Portal, 2000) which are directly and indirectly involved in research in diverse fields, ranging from Oceanography to Renewable Energy. These institutions operate under different ministries and therefore have had a tendency to work in isolation of each other (STIP, 2009). With a view to enhancing their quality and performance they should be encouraged to work in collaboration with each other. Chou et al. (2008) recommend "*the establishment of partnerships, and cooperation between universities*" in order to improve performance. The setting up of a Science Park which will cooperate with all research institutions can give rise to some tension in the research sector which will in turn increase rivalry and thus improve the quality of the research institutions. This leads to **Question Three**:

Qu_3: Will the setting up of a Science Park in Mauritius will improve the quality of the research institutions in the country?

IV. Variable: Access to Venture Capital and Company spending on R&D (See Figs.4.14, 4.15)

Innovation is of limited value without commercialization (Howells & Michie, 1998, as cited by Seyoum, 2004) and in order to transform innovative ideas into enterprises, one needs access to funds. As shown in Figs. 4.14 and 4.15, compared to the other countries, there is a need for the innovator in Mauritius to have more access to venture capital as well as companies to increase their spending on R&D. Rasmussen et al., (2006) elaborate on a number of funding schemes available in Nordic countries to create and sustain emerging high-tech companies in Science Parks. These schemes are based on either government

funding or funding from private venture capitalists. In the former case, the government may or may not want to retain some ownership of the company that would be created through seed money. In the case of private venture capital, the innovator must be prepared to give up some of the ownership and equity (Rasmussen et al., 2006). In Mauritius, the expenditure on Research & Development is about 0.3% of the GDP, of which almost the whole emanates from government sources. The private sector contributes little to R&D (STIP, 2009). One therefore postulates **Question Four**:

Qu_4: Will the setting up of a Science Park in Mauritius will attract more venture capitalists as well as encourage companies to invest more in R&D?

V. Variable: Intensity of local competition, labour management, procedures and time to set up a business (See Figs. 4.16, 4.17)

The intensity of rivalry or competition among local firms in Mauritius is low compared to the other countries. This is primarily because of market domination by a few big players. It is not anticipated that the labour management nor the procedures and time to set up a business will be affected by the setting up of the Science Park. However, the creation of a Science Park may increase local competition as firms compete to get a location in the Science Park with all the associated perceived benefits. These benefits vary depending on the mandate of the Science Parks and whether these are government led or university holdings or owned by the private sector (Wright et al., 2006). In general, the benefits include access to seed funding and venture capital as well

as access to university infrastructure. In some Science Parks, incubator services are included and these can provide management nurturing and marketing assistance as well (Grimaldi & Grandi, 2005). Lofsten & Lindelof (2003) compare the performances of firms located on and off Science Parks and they report that firms located on the parks in Sweden had higher growth, sales and employment compared to firms located off the parks. Likewise, Rasmussen et al., (2006) describe how "*university technology incubators added value to their tenant firms, specifically through university related inputs, such as university image, laboratories and equipment and student employees*". Therefore **Question Five** is:

Qu_5: Will local firms compete to be located inside the Science Park?

VI. Variable: Intellectual Property Protection (See Fig. 4.19)

A major reason for the growth of Science Parks in many countries and in particular the USA has been the passing of Acts such as the Bayh & Dole Act in the USA (Siegel et al., 2003) which allow researchers undertaking research using state funding to own the intellectual property rights. This has been a significant boost for universities and other private institutions to set up Science Parks (Amirahmadi & Saff, 1993). Rasmussen (2006) describes how intellectual property rights vary from country to country. In Nordic countries, "*the scientific employees at universities have traditionally owned the property rights to their works*". In the context of Mauritius, the legal framework needs to be clarified with regard to intellectual property rights derived from government funded research. As can be seen from figure 4.19,

Mauritius has to improve on its intellectual property protection, compared to the other countries. The Mauritius Research Council which is the main government research funding institution operates under its Act (1992) which stipulates that all intellectual property derived from projects funded by the Council belongs to the Council. This law needs to be revised in order to enhance the research sector. To that effect, **Question Six** is:

Qu_6: Will the setting up of a Science Park in Mauritius require that Intellectual Property generated from state funding be granted to the researcher/research institute undertaking the research?

VII. Variable: Size of local market (See Fig. 4.20)

The rate of growth of home demand can be more important to competitive advantage than its absolute size and rapid domestic growth leads a nation's firm to adopt new technologies faster (Chang el al., 1998). Although Mauritius has the smallest domestic market (fig. 4.20) among the four selected countries, it nevertheless can boast one of the fastest growing economies in Africa. Over the last decade, the GDP of the island has been increasing by an average of 5% annually (WEF, 2009). According to Porter (1998, p. 92), countries with small home market are forced towards export which in turn exposes them to global competitiveness. In the case of Mauritius, the potential market for export can be significant if one were to consider the regional economic block of SADC (Southern African Developing Countries, 2000) which groups some 14 countries and to which Mauritius has been a member since 1995. The SADC market has an average GDP of over $300

billion. This represents a potentially lucrative market particularly with the recent removal of many tariff and non-tariff barriers to export in the economic block. **Question Seven:**

Qu_7: Will the setting up of a Science Park in Mauritius increase exportation to the SADC countries?

VIII. Variable: Buyer Sophistication and Characteristics (See Fig. 4.21)

From figure 4.21, one notes that Mauritius has lower buyer sophistication than Malaysia and Singapore. Chang et al., (1998) hypothesize that a higher level of education of the consumers can increase demand sophistication. The literacy rate in Mauritius is over 90% (CSO, 2000) and the tertiary enrolment at universities is increasing yearly (TEC, 2000). On the basis of these, one can conclude that the local buyers are getting more sophisticated and therefore "*early saturation"* of their needs (Porter, 1998, p. 96) can be expected and this would lead to local firms innovating further. Porter (1998) is also of the view that "*a way in which domestic demand conditions can pull through foreign sales is when domestic needs and desires get transmitted to or inculcated in foreign buyers*". To that effect, every year some 900,000 tourists visit the island of Mauritius (CSO, 2000) and the government plans to increase this number to 2 million by the year 2015 (MauritiusPortal, 2000). Through the Science Park, firms may be motivated to produce technological and other products which convey the local tastes and culture to the tourists. A good example of this would be the local rum which is highly prized by the tourists visiting the island. Such a product can be transformed into a more "high value" drink

through innovative distilling, packaging and marketing. Given this potential market, the following **Question Eight** can be envisaged:

Qu_8: Will the setting up of a Science Park in Mauritius create new products for the tourism industry?

IX. Variable: Cluster Development and the quality of Suppliers (See Fig. 4.22)

Related and supporting industries enhance the activities in the value chain and are complementary to firms (Chang et al., 1998). From figure 4.22, one notes that Mauritius lags behind Malaysia and Singapore with regard to both quantity and quality of suppliers. This is an obstacle which the country has to surmount because, for a given sector, the supplier industries can have strong backward and forward linkages with the firms thus enabling the sharing of information and know-how while acting as a "*conduit*" for the transmission of innovative ideas. Porter (1998, p. 138) is of the view that the most potent influence on the development of related and supporting industries is aggressive domestic rivals. From above discussions, it was also noted that a Science Park can lead to stronger domestic firm rivalry. Indeed, in many countries Science Parks have led to an agglomeration of supplier companies and the formation of clusters which serve the needs of firms (Wonglimpiyarat, 2006). Moreover, as Mauritius is a small island, this can provide all the benefits of cluster networking associated with geographical concentration of suppliers. This leads to **Question Nine**:

Qu_9: Will the setting up of a Science Park in Mauritius improve the quantity and quality of the suppliers?

X. **Overall Aim:** From the above set of core questions, and since the ultimate objective of the setting up of a Science Park is to promote a culture of entrepreneurship and facilitate the creation of new high-tech enterprises on the island, one formulates the following **Question Ten**:

> *Qu_{10}: Will the setting up of a Science Park in Mauritius promote entrepreneurship and create new high-tech enterprises?*

Appendix Two

Qualitative Survey on the potential roles of a Science Park in Mauritius

Thank you for having accepted to participate in this interview. The survey is part of a study by the Mauritius Research Council. I appreciate you giving time to this survey. It should not take more than 1 hour of your precious time. All information will be treated with strictest confidentiality and a soft copy of the summary of results will be shared with participants upon request.

Arjoon Suddhoo
(December 2009)

Interview Questionnaire

A Science Park can be considered as a linkage between a University and Industry. It is a place where scientific and technological expertise, business expertise and sometimes financial resources are made available to those with innovative ideas in order to transform these ideas into enterprises. If a Science Park were to be created in Mauritius, please give your views on the following:

Name: .....
Position:.....
Organization:.....
Date:.....

Question One:
The setting up of a Science Park in Mauritius will attract more students to undertake science and engineering subjects.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Two:
The setting up of a Science Park in Mauritius will improve the technology absorption of the country.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Three:

The setting up of a Science Park in Mauritius will improve the quality of the research institutions in the country.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Four:

The setting up of a Science Park in Mauritius will attract more venture capitalists as well as encourage companies to invest more in R&D.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Five :

Local firms will compete to be located inside the Science Park.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Six :
The setting up of a Science Park in Mauritius will require that Intellectual Property generated from state funding research programs belongs to the researcher/research institute.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Seven:
The setting up of a Science Park in Mauritius will increase exportation to the SADC countries.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Eight :
The setting up of a Science Park in Mauritius will create new products for the tourism industry.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Nine:
The setting up of a Science Park in Mauritius will improve the quantity and quality of the suppliers.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

-

Question Ten:
The setting up of a Science Park in Mauritius will promote entrpreneurship and create new high-tech enterprises.

1 **Strongly DISAGREE**	**2**	**3**	**4**	**5**	**6**	**7** **Strongly AGREE**

Please give reasons for your ranking

-

-

-

Exit Question:
Is there anything else that you would like add on the issue of setting up a Science Park in Mauritius?

Thank You so much for your time.

Appendix Three: Sample of Segmented Qualitative Data in Matrix Form from a Business Manager

	Qu.1 Status of Science in Mauritius?	**Qu.2 Attract more students to science?**	**Qu.3 Improve Tech Absorption?**	**Qu.4 Improve quality of research?**	**Qu.5 Attract more venture capitalists and increase investment in R&D?**	**Qu. 6 Local firms will compete to be located in the park?**
BusMan1	WE have a distant market and we are distant from cutting edge research activities. Therefore there is a time lag although better now with modern communications. Must be able to access and use S&T. No natural resources. Must be innovative and originality. Use technology in an unprecedented way. Science can give this to Mts. Must get our people to be trained in science. Must develop other resources.	The proof of the pudding is in the eating. SP* is the practical side of science and its application. More meaningful to the youths who are looking for a vocation in life. Move away from the theoretical notion. SP is an abutment. **Grading 6/7** * Science Park	Yes, undoubtedly. SP is an abutment to build the scientific bridge. SP will make the transfer of technology practical. **Grading 6/7**	Need participation of leading research institutions. Research is underfunded. Mts very poor in research. Therefore SP will enhance the image of science. Will also create Job opportunities. **Grading 5/7**	No. Venture capital organisations are looking for economies which are expanding quickly. They would want to be part of the management of the enterprises they fund. They also invest in small to medium companies. They expect people to come to them rather than chasing projects. The technologist will have to have a good business plan. Business planning is not the vocation of a SP. **Grading 2/7**	Depend how the SP is sold. SP needs to be explained to the SME. SP can be seen as an extension of the university. The role and functions need to be explained. All depends how the SP is marketed. **Grading 2/7**

	Qu.7 Will Require Gov. to give IPR to Researchers /Institutes?	**Qu.8 Will increase exportation to SADC?**	**Qu. 9 Will create new products for tourism?**	**Qu. 10 Will improve quantity and quality of suppliers?**	**Qu. 11 Will improve entrepreneurship and create new enterprises?**	**Qu. 12 Any other related issues you would wish to discuss?**
BusMan1	If gov is funding and wants all the IPR, that could be a disincentive. Gov should look at the broad picture and the overall economic development. IPR should be given to the researcher/institutions. **Grading 6/7**	It could, depending on how the SP is sold to the SADC countries. SP is a new venture. It will need people, space, and needs to be marketed. People should be encouraged to visit the SP. (SP should be a joint gov/private sector and not entirely gov). This project needs scientists and captains of industry who believe in S&T. **Grading 3/7**	No strong correlation between SP and tourism. The tourists come here for other reasons. The SP cannot solve all our problems. **Grading 1/7**	Outsourcing is done in favour of SME's. The SME's thrive in the informal sector. They do not want to pay taxes, etc. Let them stay informal for the first 5 years. They provide jobs. The entrepreneurs may not be highly literate. **Grading 2/7**	It could, depending on how the SP is sold. The marketing of the SP is key. People need to understand its role and functions. **Grading 3/7**	A SP should be treated like a business enterprise. It needs similar resources and also marketing of the SP. (SP need to be accessible to the public, not necessarily near a university , it could be treated like an intellectual excursion)

Appendix Four

Mauritius Research Council

Setting up of a Science Park in Mauritius

Your Valued Contribution in less than 30 minutes

Your Company has been selected by the Mauritius Research Council to provide inputs to an important proposal of setting up a Science Park in Mauritius. We kindly request you to assist the Council by reading this covering letter and completing the attached questionnaire. This should not take more that 30 minutes of your precious time.

What is a Science Park?

Many countries have set up Science Parks with a view to enhancing the growth of new innovative enterprises by creating an environment which brings together universities, research institutions and entrepreneurs from the private sector as well as government departments. The services offered by a Science Park enable the incubation of new businesses and these services include the following:

- Scientific and technological expertise;
- Development of Business and Marketing Plans;
- Access to funding;
- Management expertise;
- Marketing expertise for quick-time-to-market;
- Space and equipment for tenants;
- Interaction & Networking among tenants in the Science Parks; and many more incentives

Survey of Enterprises

What should be the roles and functions of a Science Park in Mauritius? What should be its governance and structure? What are the needs of the business community that the Science Park ought to fulfill?

The attached survey-form attempts to answer these questions based on your valued judgments, needs and aspirations. Please complete the form and return it by e-mail (preferably) or by fax to the Mauritius Research Council. The questionnaire can be filled online (Word format). Should you require any assistance, please call us. A summary of the findings of the survey will be sent to all those who wish so. ALL INFORMATION WILL BE TREATED WITH THE UTMOST CONFIDENTIALITY.

Deadline

We know it is a busy time for the Company, but please let us have the completed questionnaire by **28th January 2010**, so that we can evaluate your views and communicate the findings in the near future.

Thank you so much and we wish the Company a successful and prosperous New Year.

Dr Arjoon Suddhoo
Executive Director
Mauritius Research Council
6th Floor, Ebene Heights Building
Ebene, Rose Hill
Mauritius
Tel: (230) 465 1085
Fax: (230) 465 1239
Email: mrc@intnet.mu

Appendix Five

SURVEY OF ENTERPRISES

Section A: General Information

A1.1 Name of Organization

A1.2 Telephone Number

A1.3 Your Position in Organization

A2. Company's Sector of Activities (Please tick appropriate empty box)

A2.1	Agriculture		A2.8	Restaurants & Hotels	
A2.2	Livestock		A2.9	Transport	
A2.3	Food & Beverages		A2.10	Financial Services	
A2.4	Textiles		A2.11	Information & Technology	
A2.5	Construction		A2.12	Health	
A2.6	Training		A2.13	Recreation & Sports	
A2.7	Manufacturing		A2.14	Others	

A3. Personnel

	<10	10-25	26-50	51-100	100-200	>200
No. of staff						

A4. What percentage of your total staff has Science/Engineering/Technical training?

	0%	<2%	3-5%	6-10%	11-20%	21-50%	>50%
% Staff with science Qualification							

A5. Company's Revenue (Rs Million)

	<3 M	3-7 M	8-15 M	16-25 M	26- 50 M	50-100 M	>100 M
Annual Revenue							

Section B: Status of Science & Technology (S&T) in Mauritius

Please answer the following questions according to your perception:

	Questions	YES	NO	Do Not Know
	Investment in S&T			
B.1	Is Mauritius lagging behind in Science & Technology (S&T) compared to other developing countries?			
B.2	Does Government invest enough in S&T?			
B.3	Does the Private Sector invest enough in S&T?			
	Interest for science			
B.4	Are Students attracted to science subjects at schools?			
B.5	Are science related jobs better paid than others?			
B.6	Are there sufficient science-related jobs on the market?			
B.7	Does Mauritius attract the latest technology?			
B.8	Does your company use the latest technology?			
B.9	Are you aware that there is a Ministry responsible for Science?			
	Develop New Resources			
B.10	Does Mauritius have the scientific knowhow to exploit its marine resources?			
B.11	Does Mauritius have the scientific knowhow to exploit its Renewable Energy resources?			
	Research Institutions			
B.12	Do our Research Institutions/Universities deliver quality research?			
	Do our Research Institutions/Universities develop projects of commercial value?			
B.13	Are there duplications in our Research Institutions?			
	Should there be more Institutions involved in Research?			
	Impact on the Economy			
B.14	Do you think that more S&T can improve the quality of our supplier industries			
B.15	Do you think that more S&T can attract Multi-National companies?			
B.16	Do you think that more S&T can improve the Tourism Sector?			
B.17	Do you think that more S&T can improve our exportation?			

Section C: Access to Scientific/Technological Information

C1. What are your company's sources of information regarding new Technology? (Please tick; 1=Not at all Important; 7=Very Important)

		1	2	3	4	5	6	7
C1.1	Competitors							
C1.2	Suppliers							
C1.3	Customers							
C1.4	Local Universities/Research Institutions							
C1.5	Overseas Consultants							
C1.6	Internet							
C1.7	Conferences/Meetings							
C1.8	Fairs/Exhibitions							
C1.9	Journals/Magazines							

Section D: Linkages with local Universities/Research Institutions.

D1.1 In the last 3 years, how many interactions with the local university or research institutions have your company had?

0	1 - 3 times	4-10	11-20	21-50	>50 times

D1.2 How would you rate the overall quality of the interaction? (1=Very Bad; 7=Excellent)

1	2	3	4	5	6	7

Section E: New Business Creation

E1. Where does your company get new ideas for business from? (Please tick; 1=Not at all Important; 7=Very Important)

		1	2	3	4	5	6	7
E1.1	Friends/Families							
E1.2	Business Community							
E1.3	Internet							
E1.4	Local Universities/Research Institutions							
E1.5	Government Funding Agencies							
E1.6	Private Venture Capitalists							

E1.7	Customers							
E1.8	Competitors							
E1.9	Others							

E2. How does your company access funding for a new business idea? (Please tick; 1=Not at all Important; 7=Very Important)

		1	2	3	4	5	6	7
E2.1	Company 's own funds							
E2.2	Friends/Families							
E2.3	Banks							
E2.4	Government Funding Agencies							
E2.5	Private Venture Capitalists							
E2.6	Others							

E3. How does your company get management assistance (including marketing) for the business? (Please tick; 1=Not at all Important; 7=Very Important)

		1	2	3	4	5	6	7
E3.1	Company's own initiatives							
E3.2	Friends/Families							
E3.3	Business community							
E3.4	Government Agencies							
E3.5	Private Venture Capitalists							
E3.6	Local Consultants							
E3.7	Overseas Consultants							
E3.8	Others							

E4. Would you AGREE or DISAGREE to the following constraints to new (high-tech) business development in Mauritius? (Please tick; 1= Strongly Disagree; 7 = Strongly Agree)

		1	2	3	4	5	6	7
E4.1	Lack of New Business Ideas							
E4.2	Slow Technology Transfer							
E4.3	Lack of Science & Technology Personnel							
E4.4	Difficult access to funding							
E4.5	Lack of Private Venture Capitalists							
E4.6	High Cost of franchising/licensing/ patenting							
E4.7	High cost of prototyping							
E4.8	Poor quality of supplier industry							
E4.9	Output from local research institutions has little potential for							

	commercialization							
		1	2	3	4	5	6	7
E4.10	Lack of management expertise							
E4.11	Lack of marketing intelligence							
E4.12	Lack of expertise in developing business/marketing plans							
E4.13	Small local market							
E4.14	Poor access to regional markets							
E4.15	Lack of business nurturing facilities in the initial stages							
E4.16	Lack of knowledge sharing among firms							
E4.16	Mauritius does not have a 'business risk-taking' culture							
E4.17	Lack of industrial space for manufacturing							
E4.18	Not Enough Multi-National Companies in Mauritius							
E4.19	Inability to attract overseas well-qualified Mauritians to return and work in Mauritius							
E4.20	Others							

F: Setting up of a Science Park to encourage the growth of new (high-tech) businesses

F1. If a Science Park were to be set up in Mauritius, how importantly would you rate the following requirements: (1=Not at all important; 7=very important)

	Services to be provided by Science Park	1	2	3	4	5	6	7
F1.1	Scientific and Technological expertise							
F1.2	Access to seed funding during new business concept stage							
F1.3	Access to funding to expand the new business							
F1.4	Access to university laboratories/workshops							
F1.5	Access to university academics/consultants							
F1.6	Access to shared equipment							
F1.7	Access to powerful (super) computers							
F1.8	Facilities for prototyping and testing							
F1.9	Manufacturing space							
F.10	Office space							
F1.11	Rent breaks (Delayed rents for an initial period for new businesses)							
F1.12	Secretarial facilities							
F1.13	IT communications and Internet facilities							
	Management/Marketing Support	1	2	3	4	5	6	7
F1.14	Assistance with the Accounts/Pay rolls/Financial skills							
F1.15	Management Coaching							
F1.16	Day-to-day operational support							
F1.17	Human Resource Recruitment/Management							
F1.18	Part-time Student employees							
F1.19	Development of Business and Marketing Plans							

F1.20	Access Market Intelligence reports							
F1.21	Access to university libraries and knowledge databases							
F1.22	Patent Search/Patenting/Intellectual Property Rights Expertise							
F1.23	Access to the Business Networks							
F1.24	Assistance in seeking commercial partners							
F1.25	Purchasing facilities							
F1.26	Interface with Supplier Industries							
F1.27	Any Other Service? (please specify)							
	Financial Sustainability of Science Park	1	2	3	4	5	6	7
F1.28	Do you think the Science Park should be PROFIT MAKING?							
F1.29	Do you think the Science Park should be for NON-PROFIT?							
F1.30	Should the Science Park charge a fee for its services?							
F1.31	Should the Science Park retain a percentage of the revenue from the new business?							
F1.32	Should the Science Park own some equity in the new business?							
F1.33	Should Government provide Tax Incentives for enterprises to undertake Research and Development?							
F1.34	Any other financial issues? (please specify)							
	Governance	1	2	3	4	5	6	7
F1.35	The Science Park should be an entirely Government initiative							
F1.36	The Science Park should be an entirely Private Sector initiative							
F1.37	The Science Park should be a joint Gov/Private Sector initiative							
F1.38	Any other governance issue? (please specify)							
	Structure	1	2	3	4	5	6	7
F1.39	The Science Park should a new institution							
F1.40	The Science Park should be a networking of existing institutions							
F1.41	Any other issue of structure (please specify)?							

Any Other Related Issues

Is there any other related information you wish to share?

Thank you for your precious time. A summary of the findings will be shared to those who wish so. Please return (preferably by email) the completed form to:

Mauritius Research Council
Ebene Heights
6th Floor
Ebene
Mauritius
Tel: 465 1085
Fax: 465 1239
Email: mrc@intnet.mu

Appendix 6

(a) Statistical Output for Logical Regression – Dependent Variable 'Enhance Export'

Null Deviance	21.1527711
Model Deviance	10.29610989
Improvement	10.85666121
p-Value	0.0010

Regression Coefficients	Coefficient	Standard Error	Wald Value
Constant	-7.031164635	4.147863249	-1.695129326
ST Expertise	1.198754207	1.210294175	0.990465154
Manu. Space	0.361042912	0.83949074	0.430073728
IT Communications	0.43538502	1.496451884	0.290944884
Univ. Libraries	-0.144809306	0.949486534	-0.152513281
Access to Bus. Network	1.492354599	1.190961223	1.253067329
Purchasing Facilities	-0.587921242	1.474664693	-0.398681303
Supplier Industries	-0.90276828	1.649164833	-0.547409369
Tax inc. for R&D	-0.032075766	1.058315435	-0.030308323

Classification Matrix	1	0	Percent Correct
1	36	0	100.00%
0	1	2	66.67%

Summary Classification	Percent
Correct	97.44%
Base	92.31%
Improvement	66.67%

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	10.296[a]	.243	.580

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Export		Percentage Correct
			0	1	
Step 1	Export	0	2	1	66.7
		1	0	36	100.0
	Overall Percentage				97.4

a. The cut value is .500

(b) Statistical Output for Logical Regression – Dependent Variable 'Attracting Multi-National'

Summary Measures	
Null Deviance	36.70796853
Model Deviance	29.73878685
Improvement	6.969181686
p-Value	0.0083

Regression Coefficients	Coefficient	Standard Error	Wald Value
Constant	-4.635973208	2.800894076	-1.655176198
ST Expertise	0.661773314	0.461606244	1.433631634
Accounts/Pay/Fskills	0.230430273	0.513002229	0.449179867
Man. Coaching	0.217622673	0.698504179	0.311555292
day-to-day support	-0.01338316	0.851198497	-0.015722725

Classification Matrix	1	0	Percent Correct
1	30	2	93.75%
0	6	1	14.29%

Percent

Summary Classification

Correct	79.49%
Base	82.05%
Improvement	-14.29%

Classification Table[a,b]

Observed			Predicted		
			mnc		Percentage Correct
			0	1	
Step 0	mnc	0	0	7	.0
		1	0	32	100.0
	Overall Percentage				82.1

a. Constant is included in the model.

b. The cut value is .500

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	29.739[a]	.164	.268

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.