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SCIENCE PARKS AS MECHANISM TO ENHANCE THE DEVELOPMENT OF A KNOWLEDGE-BASED ECONOMY IN MOZAMBIQUE

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DECLARATION

I hereby declare that, "Science Park as mechanism to enhance the development of a knowledge-based economy in Mozambique" is my own work, that it has not been submitted before for any degree or assessment in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

Alexandra Luis Mhula

29 February 2012

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ABSTRACT

The 21st century marked the beginning of an era in which countries became increasingly dependent on information and communication technology (ICT). Technological change has not only become one of the key contributors to economic growth, it is also regarded as an essential element to enhance the general welfare of society (Hu, 2006). Not surprisingly, even governments of developing countries undertake various activities aimed at internalising the positive external impact of technological innovation in order to enhance the development of knowledge-based economies. Examples are the provision of basic information services, such as telephone- and internet services as well as distance learning technologies to make education more generally accessible.

Another instrument that recently gained worldwide interest is the development of science parks, also known as information technology (IT) parks, techno parks or cyber parks. The rationale is to promote technological change, regional and/or urban development and to facilitate the diffusion of knowledge and technology through the establishment of knowledge networks. In 2004 there were approximately 600 science parks in the world, 70 percent of which were situated in the United States of America, Europe and Asia, but there is a growing trend towards its establishment in developing countries. However, the financing of such mega-projects in developing countries is especially problematic. A science park can be provided as a pure public project or pure private or through public-private partnerships (PPPs). Pure public financing is usually found in countries that have strong public sectors, such as China and India. On the other hand, in countries with well-developed private sectors they are mostly privately financed. In the case of most developing countries, private sectors are generally not developed enough and the public sectors cannot afford to finance projects of such a nature on a sustainable basis. These countries have no other option but to investigate the possibility of some other variation of a public-private-partnership (PPP) model.

The Mozambican government acknowledges the urgency to enhance the development of a knowledge based economy and regards the establishment of a science park as a necessary policy intervention to provide the institutional basis for the diffusion of technological and communication innovation. As a result the country launched its first science park, to be developed in different stages, in 2008. But the real challenge for Mozambique lies in the financing of the park. It was estimated that only the first phase will require about 25 million USD. These funds were secured from the Indian government in the form of a loan. However, the government of Mozambique relies to a large extent on foreign aid to balance the national budget and there are no surplus funds to secure the sustainability of a project of such magnitude.

This study firstly explored the economic rationale behind the establishment of a knowledge-based economy and the development of ICT. It then focused on science parks as institutions to secure the diffusion of technological innovation in Mozambique and also on empirical evidence from countries that have benefited greatly from investment in science park projects. The study also investigated the possibility to use a PPP-type of project to finance the science park in Mozambique and pointed out very important determinants for the successful implementation of PPP-projects. The study showed that the government of Mozambique is serious in its efforts to develop a knowledge-based economy although many projects are still in their 'infant' stages. It is strongly recommended that policy makers in Mozambique should study the outcomes of empirical research on various science parks projects in other

developing countries. The study shows that Brazil seems to be successful in its use of a PPP for the country's science parks. Policy makers should also pay careful attention to other PPP-projects in Mozambique. Although they are mostly used for infrastructural projects, some failed, while others seem to be functioning efficiently and important lessons can be derived.

Key concepts: knowledge-based economy*;* information and communication technology*;* knowledge networks; models of innovation, science park; spill-over effects; public-private partnership; model of financing; developing countries; Mozambique

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LIST OF ACRONYMS

ADB – Asian Development Bank
AISI – African Information Society Initiative
ASD – Alternative Service Delivery
AURRP – Association of University Related Research Parks
BOO – Build Own Operate
BOT – Build Own Transfer
CTID – Centre for Technological Innovation and Development
DBO – Design Build Operate
DBOM – Design Build Operate Maintain
DBOO – Design Build Own Operate
DBOOT – Design Build Own Operate Transfer
DFI – Development Finance Institution
EIB – European Investment Bank
EPCI – Evolution for Communication and Information Project
FDBOM – Finance Design Build Operate Maintain
FDI – Foreign Direct Investment
FIPAG – Investment Fund and the Heritage Water Supply
GDP – Growth Domestic Product
GoM – Government of Mozambique
HCB – Cahora Bassa Hidroelectricity
HCT – Human Capital Thery
HEI – Higher Education Institution
IASP – International Association of Science Parks

ICT – Information and Communication Technology
ICT4D – Internet and Communication Technology for Development
IFC – International Financial Corporation
IMF – International Monetary Fund
IPR – International Property Rights
MICTI – Mozambique Information and Communication Technology Institute
NCT – Neo-Classical Theory
NGO – Non-Government Organization
NGT – New Growth Theory
NIS – National Innovation Systems
NTBF – New Technology-Based Firms
OECD – Organization for Economic Cooperation and Development
PFI – Private Financial Initiative
PPP – Public-Private Partnership
PRGF – Poverty Reduction Growth Facility
R&D – Research and Development
RIS – Regional Innovation Systems
ROO – Rehabilitate Operate Own
ROT – Rehabilitate Operate Transfer
SADC - -Southern African Development Community
SME – Small and Medium Enterprises
SP – Science Park
TIC – Technology and Innovation Centre
UEM – University of Eduardo Mondlane

UKSPA – United Kingdom Science Park Association
VFM – Value for Money

CHAPTER ONE

INTRODUCTION

1.1. PROBLEM STATEMENT

The 21st century marked the beginning of an era in which countries became increasingly dependent on information and communication technology (ICT) to stimulate economic growth and development. Davitt (2001) referred to Stiglitz[1] (1999:1) who claimed that "Knowledge and information[2] is being produced today like cars and steel were produced a hundred years ago". Knowledge and advanced information technology are some of the key ingredients of a knowledge-based economy, which is the ultimate goal of most modern economies. Countries around the world have seen the potential benefits of becoming knowledge-based economies in terms of the contributions it can make towards economic growth and human progress (Hu, 2007: 77). According to Houghton and Sheehan (2000: 11) a knowledge-based economy is nothing more than a

> *"hierarchy of networks, driven by the acceleration of the rate of change and the rate of learning, where the opportunity and capability to get access to and join knowledge-intensive and learning-intensive relations determines the socio-economic position of individuals and firms".*

One example of a country that experienced a successful transformation into a knowledge-based economy is China. Over the past couple of decades the country's economic progress can be ascribed to various factors, such as an increase in the number of highly skilled engineers and scientists, academic infrastructure investment, as well as an increasing capacity to conduct research and development (R&D) and to attract foreign direct investment (FDI) (Li and Florida, 2006: 2). Another good example of a knowledge-based economy is India. Over the past two decades the country became a major hub where knowledge is used as a powerful instrument to enhance economic growth and development (Dahlman and Utz, 2005: 2). The government of India was proactive in putting in place an effective institutional

[1] Stiglitz is a Nobel Prize winner in economic science in 2001 (Davitt, 2001)

[2] Knowledge and information are two different concepts explained in more detail in Chpater Two.

regime with appropriate policies and institutions to support quality education, skills development, innovation and ICT (Shahid, 2009: 131).

These two examples illustrate that to achieve a knowledge-based economic structure it is necessary to establish strong institutional support for all sectors of the economy, especially in engineering, telecommunications, infrastructure, education, health, and other high-tech sectors that use advanced technology in their production processes. Some examples of high-tech sectors are: biotechnology, computer software, telecommunications, electrical engineering, etc.

Institutional support played a major role in creating knowledge-based economies around the globe. This support can be illustrated by the various programmes in developed and especially in developing countries that focused on promoting ICT and innovation. Some examples of these ICT supporting institutions are: Digital Opportunity Task Force of the G-8 governments, ICT Task Force of the United Nations[3], the African Information Society Initiative (AISI)[4] and the New Partnership for Africa's Development[5] (Department of Science and Technology of Mozambique, 2009).

However, many developing countries, and especially those in Africa, are struggling to successfully transform their economies to enjoy the advantages of information and communication technology. Despite the fact that information is characterised by mobility, which is the flow of information and knowledge from countries that have the knowledge to countries that need such knowledge, the gap between information-rich and information-poor countries is increasing (Ernst and Lundvall, 2004: 261). This dilemma has received increasing attention from governments of many countries and each of these governments are introducing various policy instruments to improve the diffusion of ICT in their respective economies.

[3] The objective of Digital Opportunity Taskforce and ICT Task Force of the United Nations is to develop strategies that bridge the global digital divide (Sachs, 2005).
[4] The goal of AISI is to build an "Information society in African countries" (Economic Commission for Africa, 2008).
[5] The New Partnership for African development, developed by African leaders is based on "a common vision that private and public sectors have a duty to eradicate poverty and place their countries, both individually and collectively, on a path of sustainable growth and development and, at the same time, to participate actively in the world economy and body politic" (Growth, 2001: 1).

It is argued that the establishment of science parks is an important policy instrument that can be effectively used to create the foundation for a knowledge-based economy. As defined by the International Association of Science Parks (IASP) (IASP International Board, 2002) a science park is:

> "*….an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions...*"

Silicon Valley in the United States of America (USA) is considered one of the oldest science parks in the world and was established in the early 20th century. It is renowned for the products of some major microelectronic manufacturers such as Apple, Intel and Hewlett-Packard (HP). Till today, Silicon Valley is considered as one of the largest hubs of technological innovation in the world where more than 330 000 high-tech workers are employed (Velibeyoglu, 2000: 13).

In 2004 there were approximately 600 science parks around the globe, 70 percent of which were situated in the USA, Europe and Asia (Department of Science and Technology, Mozambique, 2009). There is also a growing trend to establish science parks in Africa. As a result, countries like Morocco, South Africa, Tunisia, Egypt, Ghana, Senegal and Nigeria have developed and established science parks. Other SADC-countries such as Namibia, Botswana and Swaziland are in the process of establishing their first science parks (Department of Science and Technology, Mozambique, 2009).

The Mozambican government also acknowledges the importance of information and communication technology towards the development of a knowledge-based economy. The government regards the establishment of science parks as a necessary policy intervention to provide the institutional basis for the diffusion of technological and communication innovation (Department of Science and Technology, Mozambique, 2009). As a result, the first science park project was launched in 2009, which was referred to as Knowledge City by the Minister of Science and Technology (Personal interview, 2010).[6] Knowledge and experience are supposed to be shared between the inhabitants of this new city to stimulate regional growth and enhance the development of a knowledge-based economy. The science

[6] This name was given by the Minister based on the fact that this science park is almost like building a small city in a rural area of Maputo Province (Moamba).

park project in Mozambique is one of the largest ICT projects in the country and it is a major step towards a knowledge-based economy.

This specific science park is one of four parks that the government of Mozambique is planning to establish over the next couple of years. The other three parks will be strategically located near big cities with access to infrastructure, ports and airports in the north of the country, in the Nampula and Zambezia provinces. Consequently, this first science park in Moamba can be seen as a pilot project. The experience gained from this first project will be extremely valuable when planning the strategy for other science park projects.

The African Development Bank[7] accepted the responsibility of sponsoring the urban planning of the land where the park will be established (All Africa, 2010). After the planning had been completed by the Portuguese company, ParqueExpo, it is estimated that the construction of the first phase of the park will cost approximately USD25 million. These funds have been secured from the Indian government in the form of a loan. This is one of the five Lines of Credit (LOCs)[8] provided by the Indian government through the Export-Import Bank of India (Department of Science and Technology, 2009). Jaguar Overseas[9] is the construction company that signed a contract in March 2010 with the Ministry of Science and Technology and promised to deliver the first phase of the park with its first Technology and Innovation Centre (TIC) in approximately 12 months (Mitra and Bhuvaa, 2011).

The real challenge, however, lies in the financing of the remainder of the park. Like most developing countries, Mozambique is largely dependent on foreign aid which is mostly channelled to basic services such as health, education and infrastructure. Just to illustrate, government expenditure for 2011 is estimated to be about USD 4.7 billion. Only USD 2.6 billion is expected to be covered by taxes and other government revenue and USD 86 million will be raised through an issue of domestic debt. The remaining debt is to be covered by foreign loans and grants (AllAfrica, 2011). As a result, acquiring the necessary finance for the entire Science Park is a major concern.

[7] The African Development Bank is a regional multilateral development bank, engaged in promoting the economic development and social progress of African countries (African Development Bank, 2000:5)
[8] A line of credit as an "arrangement between a financial institution, usually a bank, and a customer that establishes a maximum loan balance that the bank will permit the borrower to maintain. The borrower can draw on this line of credit at any time, as long as he or she does not exceed the maximum set in the agreement" (Scarborough,Wilson and Zimmerer, 2009 : 526).
[9] An Indian Company, part of the O.P. Jindal Group.

The Government of Mozambique made a deliberate decision to finance this science park by means of a public-private partnership (PPP) (Department of Science and Technology, 2009). However, there are some concerns regarding reliance on a public-private partnership agreement for the establishment of a science park in Mozambique. Firstly, after a thorough literature search, very few examples were found where PPPs are actually applied to the development of science parks. One initiative to use a PPP model for the establishment of a science park was found in Brazil (Gargione, Plonski and Lourenção, 2010). A second concern relates to the difficulty of identifying a suitable public-private relationship for this science park, given that each partnership will depend on specific country characteristics and projects. This implies that the Government of Mozambique is faced with a huge task of being one of the first countries to establish a science park by means of a public-private partnership.

The main focus of this study is therefore on science parks as an instrument towards the development of a knowledge-based economy and on the suitability of a PPP to satisfy all the needs of such a development.

1.2 RESEARCH OBJECTIVES

The following are key objectives:

- To present a conceptual and theoretical framework as basis towards and understanding of a knowledge-based economy and of the role of information and communication technology in such an economy;
- To examine the role of science parks as instrument to create knowledge-based economies and to investigate relevant empirical evidence in order to learn lessons;
- To investigate the types of and rationale behind the establishment of public-private partnerships as well as the factors that determine a successful PPP-project;
- To present a case study on Mozambique's efforts to enhance the development of a knowledge-based economy, with a specific focus on the first science park project and its establishment with a public-private partnership agreement.

1.3 METHODOLOGY

The nature of this study is investigative and qualitative. Qualitative research is also fundamentally interpretative (Cresswell, 2003: 182). The aim was to interpret the information in a manner that allows for the derivation of meaningful conclusions. The research was conducted from a phenomenological paradigm, which concerns itself with the study of phenomena (Hussey and Hussey, 1997: 52). In this study the phenomena in question are knowledge-based economies, science parks and public-private partnerships.

The report presents a descriptive overview of the literature on the importance of knowledge-based economies, the role of and empirical evidence on science parks and its establishment by means of PPPs. A case study captures the efforts of the Mozambican government to establish a science park as instrument towards a knowledge-based economy and on its financing by means of a public-private partnership.

This research applies a comparative approach to evaluate the features and outcomes of some selected science parks and use a typology table to summarise the findings. A comparative approach is recommended by Lofsten and Lindelof (2001) in the following cases:

- In cases of real issues where policy-makers have to make tactical decisions on various strategies;
- In cases where the specific programmes are reasonably well defined and have significantly similar objectives;
- In cases of existing evidence that a project is viable and can potentially succeed.

Secondary data was used from various sources, including the OECD, World Bank and institutions of innovation and technological change.

1.4 ORGANISATION OF THE STUDY

This research report is structured in the following manner. Chapter Two examines the role of knowledge and of ICT and networks in modern economic systems. Chapter Three presents a theoretical overview of science parks as an instrument for the establishment of a knowledge-based economy. It also investigates the evolution of a science park and the economic rationale behind its establishment. Chapter Four presents a literature overview on PPPs. Chapter Five presents the case of Mozambique. It focuses on the country's efforts towards

the enhancement of a knowledge-based economy by means of the establishment of its first science park. Chapter Six concludes and offers some recommendations.

1.5 LIMITATIONS

- The scope of the study is too broad to allow for an in-depth investigation into each of the aspects of knowledge-based economies, science parks as well as PPPs. However, it was suggested by the Minister of Trade and Technology of Mozambique that the study should cover all three aspects.
- The fact that the science park is still in its first phase, means that there is no data available and no studies on its progress or on the plans to establish a PPP.

CHAPTER TWO

KNOWLEDGE-BASED ECONOMIES AND THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY

2.1 INTRODUCTION

This chapter presents the conceptual and theoretical framework. Firstly, in Section 2.2 it focuses on the meaning of a knowledge-based economy and on some theories (neo-classical, new growth and human capital) explaining the role of knowledge. It also distinguishes between the main types of knowledge. Section 2.3 explains the role of ICT and the importance of networks in a knowledge-based economy. Section 2.4 concludes.

2.2 A KNOWLEDGE-BASED ECONOMY

In modern economic systems knowledge is recognised as the key driver of economic growth and development. The emergence and popularity of the term knowledge-based economy give evidence to this recognition. In economics and probably most social sciences, a definition is the starting point for any economic theory. Terms that have inadequate or vague definitions can cause significant conceptual and measurement problems.

2.2.1 Definition

A knowledge-based economy is one of those concepts that Smith (2002: 6) identifies as highly problematic. The difficulty in defining a knowledge-based economy starts with the word "knowledge". Knowledge is a term "...hard to pin down with any precision", thereby making it impossible to define precisely (Brinkley, 2006: 29). Nevertheless, there are numerous definitions in the literature that attempt to define as closely as possible the term knowledge-economy, for example:

- *The OECD* (1996: 7) refers to economies based on knowledge as "...those which are directly based on the production, distribution and use of knowledge and information". According to this definition the effective generation and distribution of information are key ingredients of a knowledge-based economy.

In 2005 this OECD definition was broadened as follows (OECD; 2005: 71): "The knowledge-based economy is an expression coined to describe trends in advanced economies towards a greater dependency on knowledge, information and high skills levels, and the increasing need for ready access to all of these by the business and public sectors". It is interesting to note that with this definition the OECD places the emphasis on the fact that knowledge-based economies are advanced economies, thus in a way this definition excludes developing and emerging economies.

- *Houghton and Sheehan* (2000:11) define a knowledge-based economy as a "...hierarchy of networks, driven by the acceleration of the rate of change and the rate of learning, where the opportunity and capability to get access to and join knowledge-intensive and learning-intensive relations determines the socio-economic position of individuals and firms". This definition refers to the creation of knowledge-networks as another key ingredient for the development of a knowledge-based economy.

- *Brinkley* (2006: 4) also presents a number of definitions from various sources amongst which two particularly stand out because in addition to the importance of knowledge and knowledge networks, they emphasise the role of competitive advantage resulting from knowledge.

  ► Leadbeater (1999: 4) states that "...the idea of the knowledge driven economy is not just a description of high-tech industries. It describes a set of new sources of competitive advantage which can apply to all sectors, all companies and all regions, from agriculture and retailing to software and biotechnology". This definition encompasses an important aspect of competitive advantage generally accepted in economic theory and the fact that information and knowledge are not only key ingredients in the field of science, but in all sectors of the economy.

  ► A similar definition, developed by the Economic and Social Research Council (ESRC) (2005), states that "...economic success is increasingly based upon the effective utilisation of intangible assets such as knowledge, skills and innovative potential as the key resource for competitive advantage". The term

> "knowledge economy" is used to describe this emerging economic structure. This definition highlights the importance of competitive advantage created by the effective use of information and knowledge in a modern economy in which competition is an important component.

Most definitions emphasise that to develop a knowledge-based economy it is important to improve the use, distribution and diffusion of knowledge, which in turn improves the competitive advantage of economies. The following sub-section will elaborate on the role of knowledge in economic development.

2.2.2 The role of Knowledge

The importance of knowledge dates back as far as pre-antiquity (Reinert and Daastøl, 2004: 27). World renowned economists, such as Adam Smith[10], attempted to incorporate knowledge in their economic models. Therefore, the term knowledge features in most streams of economic theory, albeit from different perspectives. In recent years the interest in knowledge has grown significantly. The main reason for this interest is related to recent ICT development (See Section 2.2.4) which to some extend secures the availability of knowledge worldwide

Given these recent developments, economists are now developing new theories and revising old ones in order to incorporate knowledge in a more efficient manner. After a search of the literature to explore the rationale behind knowledge-based economies, the following three theories seem to be particularly relevant, namely:

- Neo-classical;
- New growth;
- Human capital.

Neo-classical theory is important as it can be considered the as mother of economic theory, whereby its principles and applications are accepted by most economists worldwide. As stated by North (1978: 974): "...to abandon neoclassical theory is to abandon economics as a science". The new growth theory, on the other hand, is important for this study because the OECD, the strongest institution to promote knowledge-based economies, validates this theory as the most significant for its analysis (Cortright, 2001: 2). Lastly, there is no doubt that a key ingredient in the knowledge economy is human capital. As a result, an understanding of the

[10] Adam Smith talked about individuals who significantly contribute to the economy by introducing knowledge and new skills (OECD, 1996: 11)

human capital theory is imperative to understand knowledge-based economies. These key theories will be discussed in the following sub-sections.

2.2.2.1 Neo-classical Theory (NCT)

The following are key assumptions:[11]

(a) Knowledge is exogenous

Neo-classical economic theory is based on a system with only two factors of production - labour and capital. All other factors, such as knowledge, intellectual capacity and education are assumed to fall outside of the system (Ridge, 2010: 9). In other words, knowledge is assumed to be an exogenous factor.

(b) Perfect information

Neo-classical theory makes no distinction between knowledge and information. It assumes perfect information, which means that information is shared amongst all the agents in the economy who act rational when making economic decisions.

(c) Knowledge is a public good

Neo-classical economists view knowledge as a public good which can be easily produced, exchanged and diffused (Cowan, Jonard, Özman, 2004: 469). They argue that knowledge is a public good because it has the characteristics of non-rivalry and non-excludability. Non-rivalry means that one person's consumption cannot impede another person's consumption and non-excludability means it is not possible to exclude anyone from using the good. Given these assumptions and the ease of mobility of information (knowledge), neo-classicists conclude that knowledge (similar to information) is a public good.

(d) Static modelling

NCT is based on static modelling of economic analysis, where only the current changes to the systems are considered and not the future ones.

However, these assumptions of traditional economic theory can be criticised especially on the grounds of recent developments in globalised economies. Firstly, it has been proven that information is not the same as knowledge (David and Foray, 2001: 4). Knowledge empowers individuals with intellectual capacity and leads to physical action, while on the other hand, information is nothing more than structured and formatted data until someone with knowledge uses it (David and Foray, 2001: 4). In other words, knowledge is a much broader

[11] These assumptions are knowledge related assumptions.

concept than information. In knowledge-based economies knowledge is seen as a commodity which travels through information channels (ICTs) (Harris, 2001: 25). In other words, the two complement each other, but they are not exactly similar.

Secondly, there is a constant debate between economists about whether knowledge is a public or a private good (Lundvall, 2003: 3). A private good has the characteristics of rivalry in consumption and excludability, whilst in the case of pure public goods neither of these applies (Black, Calitz and Steenekamp, 2008: 29). Recent advances in intellectual property protection[12] (IPP) in ICT illustrate that knowledge (especially high-tech knowledge) is becoming more private than public, mostly due to a phenomenon known as the free rider effect (Maskus and Reichman, 2004: 279). Free riders are individuals who benefit from a public good or a collective effort, but pay very little for it (Groves and Ledyard, 1977: 783). Consequently, the producers of knowledge protect their knowledge through private property rights (PPR), thus depending on the type of knowledge it can be regarded as pure public, private or a mixture of both (a mixed good). Lastly, having a static model in economic analysis has become highly ineffective and most modern economic theories are more inclined towards the use of dynamic modelling.

In conclusion, the neo-classical theory seems to contribute very little when it comes to a theoretical explanation of knowledge. Given its strict and often unrealistic assumptions, the theory is too restrictive to explain the complex and dynamic aspects that knowledge brings into economic theory.

2.2.2.2 New Growth Theory (NGT)

The OECD (1996: 7) strongly relies on new growth theory to explain a knowledge-based economy. As explained by Cortright (2001: 2), the theory is based on two important factors: Firstly, it incorporates the notion of technological progress into economic analysis. Secondly, it states that knowledge creates increasing returns which stimulate economic growth. The last factor is a view very different from traditional neo-classical economics where diminishing returns[13] are often assumed. Without increasing labour or capital, technological development and knowledge can lead to higher levels of economic growth (Cortright, 2001: 2).

[12] IPR is defined as "legal instruments to protect someone's intangible assets' (Stanislawska, 2007: 2).
[13] This theory assumes that in the short term the additional (marginal) production due to an increase of one of the factors of production (such as labour or capital), whilst keeping the other factor constant, will at some point start decreasing.

NGT views knowledge in a different light from NCT and it is based on three assumptions, which can be easily related to Lucas's and Romer's Endogenous Growth Theory[14] (Harris, 2001: 24). These assumptions are:

(a) *Knowledge is a type of investment*: This assumption implies that investment in knowledge should be seen in the same way as any other investment. Therefore, when investing in knowledge, the same economic considerations regarding the possible return should be applied as for any investment.
(b) *Knowledge contributes to other factors of production*: It is assumed that knowledge enriches other factors of production such as capital and labour. Thus, similar to a capital investment, this will delay the impact of the law of diminishing returns, which in turn will not decrease the marginal returns when new additional investments are made.
(c) *Knowledge accumulates*: This assumption is based on the accumulating nature of knowledge. In other words, similar to capital, knowledge can also accumulate over time and become a stock of knowledge.

Based on these assumptions the following conclusions were made by the OECD (1996: 11):

- Knowledge can increase the rate of return on investment, thereby contributing to knowledge accumulation through more efficient methods of production, as well as better products and services.
- This in turn will ensure continuous investment which will lead to sustainable economic growth rate of the country. As a result, the focus of NGT is on the importance of investment in education (human capital) and in research and development (R&D).

The last theory relates to the human capital, where knowledge forms the basis.

2.2.2.3 Human Capital Theory (HCT)

According to Harris (2001: 25) several economic theories "…use human capital as a proxy for knowledge". In the era of technological change human capital is one factor that cannot be ignored. Without human capital as a resource an economy will not be able to innovate and

[14] Endogenous growth theory explains the role of technology within the model. Romer and Lucas made an important addition to economic theory through endogenous growth theory by incorporating human capital and knowledge (Romer, 1990: 74).

adopt new technology and consequently will not be able to transform itself into a knowledge-based economy.

Human capital is broadly defined by Olaniyan and Okemakinde (2008: 158) as an "…investment people make in themselves that enhance their economic productivity". Cesen (2003: 33) explains that economic theory claims human capital to have the following five categories: "...individual knowledge, experience, skills, capability for work (health), willingness and readiness to work (personality)". These are the main elements that determine the quality and availability of human capital in a country.

Like any other economic theory, HCT rests on a number of fundamental assumptions[15], the most important of which holds that knowledge stimulates and improves labour productivity. Moreover, more knowledgeable labour will create technological change, which in turn will induce economic growth (Laroche and Merette, 1999: 88). Workers who have greater skills (also communication skills) and knowledge should in general perform better than other workers, and would need less effort to perform any given task and will learn faster. Therefore, it is expected that these workers would be more productive, especially when it comes to the use of advanced technologies which require specific abilities (Fuente and Ciccone, 2002: 7).

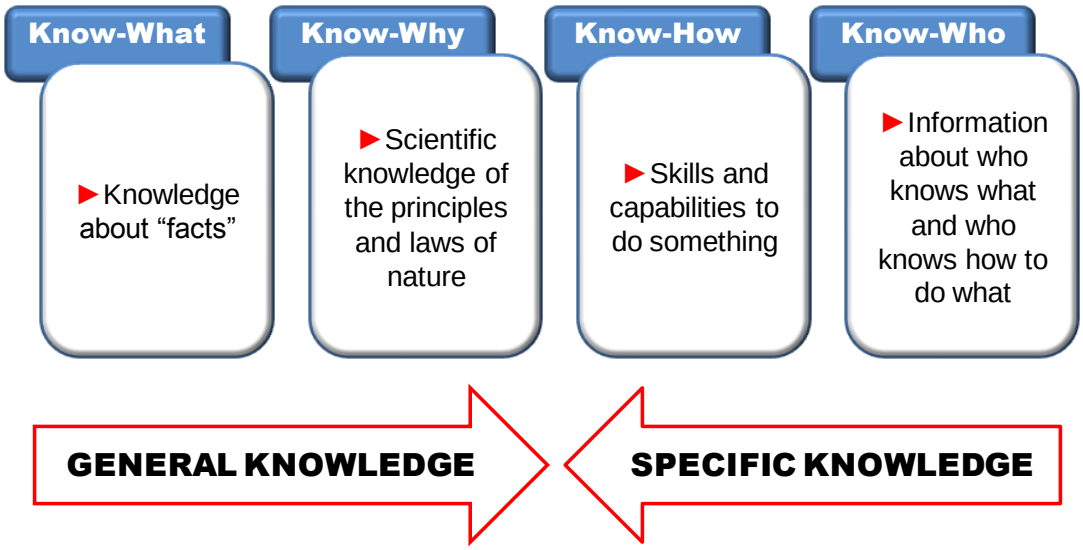
To summarise, it can be said that most streams of theory consider knowledge as a key ingredient for economic growth and development. In the traditional neo-classical theory knowledge is an important factor. However, it exogenously impacts on the production function and ultimately on economic growth. Most recent economic theories, such as the new growth and human capital theories incorporate knowledge more directly into production functions and accept that knowledge is the key ingredient to enhance the development of knowledge-based economies.

2.2.3 Types of Knowledge

There are four main types of knowledge (OECD, 1996: 11) which are highlighted in Figure 2.1 and then explained in more detail.

[15] Some of the assumptions are that wage is a function of human capital and that capital markets are perfect with free entry (Livingstone, 1997:9).

Figure 2.1 Types of Knowledge



Source: Lundvall and Johnson, 1994 : 26

(a) *Know what:* This is the type of knowledge which is related to facts. It is closely related to information and consequently it can be broken down to into bits and communicated as data. Medical sciences and law are areas where this type of knowledge is widely applicable (OECD, 1996: 12).

(b) *Know why:* This type of knowledge is largely based on principles and the laws of nature, as applied in the human mind and in society. It is of particular importance for technological development and advances in products and processes (Johnson, Lorenz and Lundvall, 2002: 252). Know-why is often organised in highly specialised institutions, like universities and laboratories. Access to this type of knowledge requires interaction with these institutions through recruiting specifically trained labour or through joint activities.

(c) *Know how:* Know-how refers to skills or the ability to do something (Lundvall and Johnson, 1994: 26). Although this type of knowledge was initially mainly applied to artisans and production workers, it currently plays a significant role in all layers of economic activity. This is probably the most popular type of knowledge in modern economies. It gained its popularity through the Asian economic boom and the skills and ability of the Asian people to produce practically any good or service.

(d) *Know who:* This is information about "...who knows what and who knows how to do it" (Lee and Gibson, 2002: 303). It is becoming increasingly important. This type of knowledge involves the social ability to co-operate and communicate with different types of people because it is based on the formation of social networks which allow professionals to utilise their knowledge in a much more efficient manner.

The first two types can be grouped together as general knowledge given that these can be obtained publicly through sources like books, databases, lectures, etc. (OECD; 1996: 12). The last two types can be grouped together as specific knowledge because these are often found internally in the organisation and can generally be acquired through practice and experience (Lundvall and Johnson, 1994: 27).

2.3 THE ROLE OF ICT AND NETWORKS IN KNOWLEDGE-BASED ECONOMIES

2.3.1 The role of ICT

As defined by Chowdhury and Alam (2009) ICT "…consists of hardware, software, networks, and media for collection, storage, processing transmission, and presentation of information in the form of voice, data, text, and images". ICT infrastructure refers to the accessibility, reliability and efficiency of computers, phones, television and radio sets and the various networks that link them (Goschin and Constantin, 2008: 129). ICT plays a crucial role in the global ICT-driven society. As previously, ICT plays an important role in the generation, distribution and use of knowledge amongst individuals, firms and countries (Goschin and Constantin, 2008: 129).

ICT is particularly important in developing countries, where ICT is thought to be effectively used to attend to developmental challenges (Fife and Hosman, 2007: 54). From the private sector's side, investment in the ICT sector improves connectivity worldwide, which will enhances profitability. From a developmental perspective, the benefits of improved ICT infrastructure with all its key components (software, hardware, etc) can significantly increase economic growth of developing countries and connect them to the rest of the world. In other words, ICT contribute to the mobility of knowledge between countries, which makes the knowledge more accessible. Through ICT most developing countries can access knowledge and information that previously was not affordable to improve and upgrade their production processes and thereby stimulate investment and economic growth (Chowdhury and Alam, 2009).

ICT plays a crucial role in transforming economies into knowledge-based economies given that "...ICTs facilitate the rapid collection, collation, storage and dissemination of data, thereby assisting the knowledge creation and diffusion process" (Roberts, 2000: 429). As mentioned in Section 1.1, countries like India and China are well-known for their fast economic growth and development due to their constant investment in ICT infrastructure and related sectors. Investment in projects that uses ICT is therefore essential to bridge the gap between information-poor and information-rich countries.

The development of a Knowledge Economy Index (KEI) by the World Bank further illustrates the importance of ICT in knowledge-based economies. KEI is an index that measures the level of knowledge in a country. As suggested by the World Bank (2008: 1) the KEI has four components:

- "Economic Incentive and Institutional Regime;
- Education and Training;
- Innovation and Technological Adoption;
- Information and Communication Technology Infrastructure".

One of the key variables in this index is ICT development and infrastructure (Goschin and Constantin, 2008:131). In 2008 the Knowledge Economy Index[16] includes 146 countries around the world, mostly developed countries, (European Union) but also the USA, Latin America, East and South Asia and other countries (World Bank, 2008: 2). Arab countries also recently adopted the World Bank methodology of KEI (UNDP, 2009). As the importance of knowledge and ICT grows, the number of countries using this index is expected to increase and include poor countries and emerging economies.

The KEI is a useful tool to illustrate where the country is at the moment when it comes to innovation, R&D development, science, technology and high-tech skills development. It also serves as a benchmark to evaluate their own progress in the case of countries that are striving to become knowledge-based economies.

[16] For more information of KEI refer the following website: http://info.worldbank.org/etools/kam2/kam_page5.asp

2.3.2 The importance of Networks

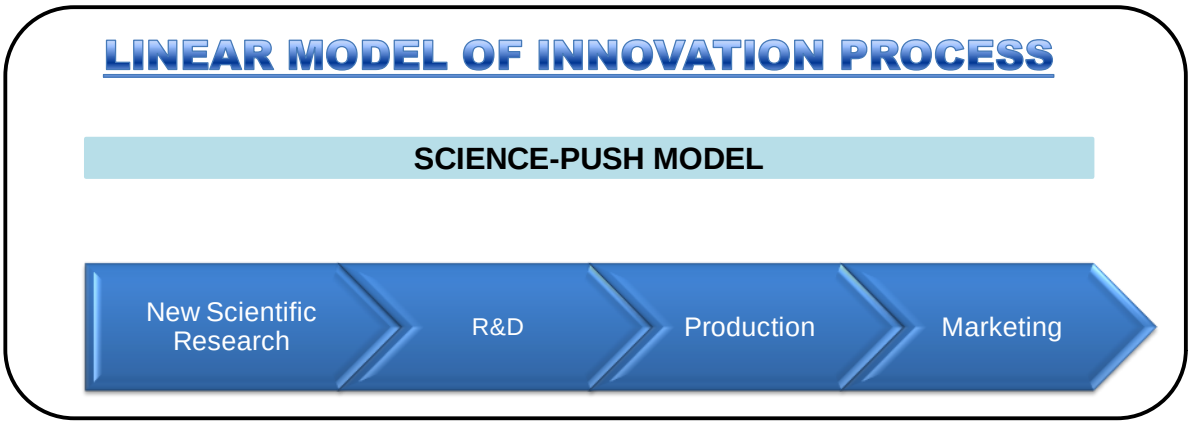
As stated by the OECD (1996: 7) some of the key aspects of a knowledge-based economy are the diffusion, creation and use of information. The more companies are able to improve on these three aspects, the more successful they will be in stimulating the efficiency and growth of their businesses. The channel through which this diffusion and use of information and knowledge can take place in the knowledge-based economy is referred to in the literature as knowledge networks (OECD, 1996: 14). Houghton and Sheehan (2000: 11) in their definition of a knowledge-based economy[17] state that a structured arrangement of knowledge networks makes up a knowledge-based economy.

Linear and non-linear models of innovation are generally used to explain knowledge networks. These models are discussed in the following sub-sections.

2.3.2.1 Linear Models

During the 1950s up to 1970s linear models were used to explain innovation. Innovation that arose from scientific development is named a science-push model. (Manley, 2002: 94). This process is illustrated in Figure 2.2 below. An example would be the very popular global positioning system (GPS) that is freely available today, but which was originally developed for military use only.

Figure 2.2 Linear Model of Innovation Process (Science-Push Model)



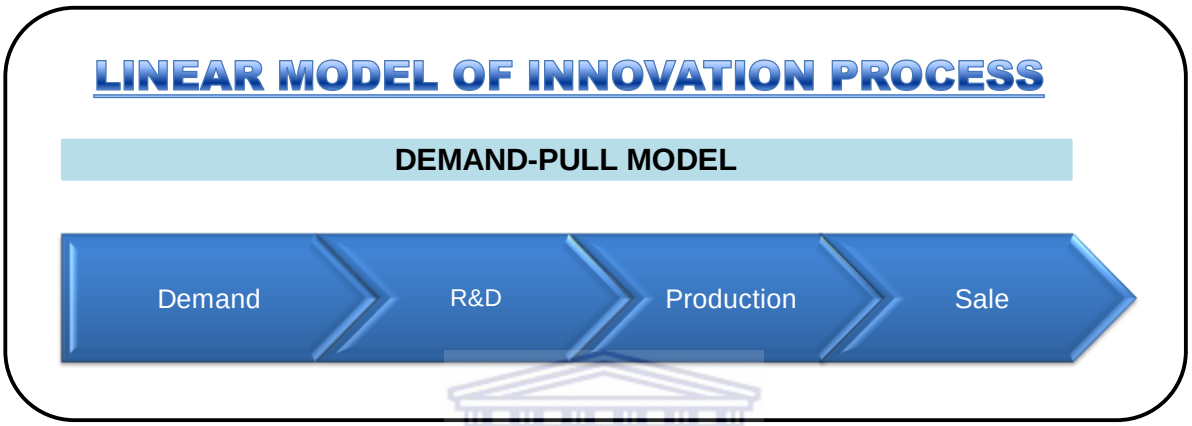
Source: Manley (2002: 94)

On the other hand, the demand-pull model, innovation would be stimulated from the demand side. An example of such an innovation is the low energy light bulb that was developed when

[17] Refer to Chapter One for this definition.

the energy crisis opened a window of opportunity in the market. As explained by the OECD (1996) it is assumed that innovation starts with a scientific discovery. Thereafter, the development of the product begins, followed by its production and then marketing. The final stage involves the sale of the product or service. This model of innovation is illustrated in figure 2.3.

Figure 2.3 Linear Model of Innovation Process (Demand-Pull Model)



Source: Manley (2002: 94)

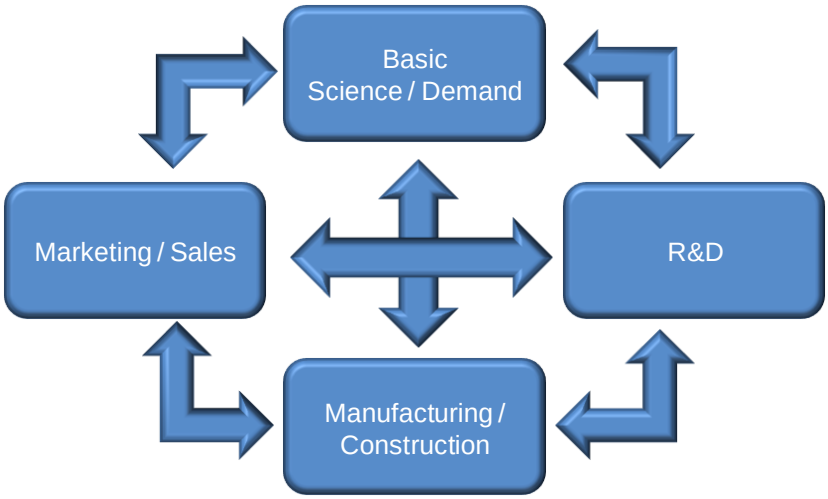
Recent evidence, however, illustrates that innovation does not necessary come from one source and that more often than not it comes from different sources and assume different forms (OECD, 2001: 14). This is when the idea for non-linear models of innovation originated.

2.3.2.2 Non-Linear Models

Manley (2002: 96) maintains that in the New Economy[18], innovation models including feedback systems are highly complex and thus the process is not completely linear. Figure 2.4 illustrates this non-linearity.

[18] New Economy is a concept that has been used since 1995 and it relates to acceleration in the rate of technical advance in information technology (Gordon, 2000: 2).

Figure 2.4 Interactive Model of Innovation



Source: Manley (2002: 95)

Unlike linear systems of innovation, non-linear systems, also referred to as dynamic systems, is a process of innovation influenced by many factors and information sources such as demand, R&D, production and marketing (Kaufmann and Tödtling, 2000: 3). Some of the common characteristics of non-linear models are highlighted below.

(a) Feedback loops

The model above illustrates that there are feedback loops between all stages of the innovation processes, meaning that innovation comes from interaction between various economic and social processes (Hobday, 1998: 26). In other words, here it is assumed that innovation originates from various sources, such as what the customers really need and want as well as from the capacity of the company to produce these desired goods and services. Innovation also comes in various forms, that is, it includes not only the development of new products, but also the upgrade of existing ones through the use of advanced technologies.

(b) Communication

Communication amongst all economic agents (customers, university, firms, etc.) is considered to be at the heart of innovation. This communication is of particular importance to those who develop and market the product (OECD, 1996: 14). Manley (2002: 96) claims that these processes became more complex with the IT revolution and globalisation. The current innovation systems approach puts a lot of emphasis on the importance of effective knowledge flows between industry, governments and academia in the development of technological and

organisational innovation (Manley, 2002: 96). This explains the need for joint collaboration and effective communication between the public and private sectors which can be achieved through the establishment of science parks.

(c) National innovation systems (NIS)

Innovation which is created through interaction of different actors in the economy establishes a base for what is referred to as a national innovation system. The concept NIS originated due to the failure of economic theory to incorporate institutions into economic modelling. These institutions include universities, public laboratories, firms, financial institutions, government regulatory bodies and all other key agents in the economy. According to Lundvall (1992: 2) NIS "...is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge'' (Godin, 2007: 7). Park (2001: 30) claims that the national innovation system is considered to be a process of interactive learning which requires the exchange of knowledge as well as cooperation between industry, government and academia with the objective to create innovation and develop science and technology.

(e) Triple Helix era

As explained earlier, lately emerging innovation models are characterised by consistent collaboration between academia, government and firms. These new collaborations are regarded in the literature as the 'triple helix era' (Lakhwinder, 2006: 17). The academia assumes the role of providing the knowledge, while government and firms invest in the required R&D and commercially utilise the knowledge that was produced by the academia. Given the dynamics of a global economy this linkage is considered to be a key ingredient to improve product and service delivery and thus to remain competitive[19] (Etzkowitz and Leydesdorff, 2000: 111).

(f) Regional innovation systems (RIS)

RIS are considered to be important for the development of various forms of knowledge and the diffusion of information which will contribute to regional economic development. This relates to an important principle of geographic concentration which will be referred to in Section 3.2, referring to the specific features of science parks. The oldest science park in the

[19] Being competitive is an essential feature a knowledge –based economy according to Brinkley. (See Section 2.2.1)

USA by the name of Silicon Valley is regarded as a RIS and it significantly contributed to the development of the surrounding area of the park (Saxenian, 1996: 2). Like Silicon Valley in the USA, many countries developed and are embarking on policies that establish RIS and other models of innovation.

2.4 SUMMARY AND CONCLUSION

In recent years, economists, researchers and policy makers are showing increasing interest in the meaning and relevance of knowledge-based economies. Even though there is no precise definition of what a knowledge-based economy is, it is argued that the creation of a knowledge-based economy is important to stimulate economic growth and development, especially in a era of globalisation with increasing interconnectedness through the used of advanced information and communication technology.

To interpret the role of knowledge in terms of economic theory has been a complex task. This complexity is amongst other things due to the diversity of knowledge and its various types and forms. Even Adam Smith referred to the importance of knowledge, but according to neo-classical thinking knowledge and education are exogenous factors. New growth theory on the other hand incorporates knowledge and technological progress as integral part of their analysis and regard knowledge as an investment which will accumulate over time. According to the human capital theory such investment in human capital will increase productivity and result in higher earnings, factors that will stimulate economic growth.

Information communication technology plays an important role in the generation, distribution and general use of knowledge and information, i.e. in the transformation of economies into knowledge-based economies. ICT makes knowledge more accessible and enhances its mobility. Another essential element in a knowledge-based economy is the creation of networks through which diffusion of knowledge and information is expected to take place. Knowledge networks are important as tools to stimulate national and regional innovation.

The establishment of science parks may be an effective policy instrument to allow for the formation and development of various types of knowledge networks, which are crucial to narrow the gap between information-rich and information-poor countries. Chapter Three accordingly investigates the role of science parks in this regard.

CHAPTER THREE
SCIENCE PARKS AS INSTRUMENT TO CREATE KNOWLEDGE-BASED ECONOMIES

3.1 INTRODUCTION

Science parks are becoming very popular amongst policy makers, especially in developing countries as a tool to encourage the development of knowledge-based economies. According to Almeida, Santos and Silva (2008: 8) "…a science park is a regional innovation policy instrument that aims to promote interactions and technology transfer, thus stimulating innovation and growth". They claim that if knowledge networks are created not only internally but also with institutions and organisations outside the park, knowledge spill-overs will occur, creating a base for the development of a knowledge-based economy. The establishment of science parks can be regarded as an ICT tool used by governments achieve this goal.

This chapter provides a review of the literature related to the role of science parks in the development of a knowledge-based economy. Section 3.2 presents some definitions and explains the general features of science parks, whilst Section 3.3 presents a brief overview of its evolution. Section 3.4 focuses on the rationale behind the establishment of science parks and on some opposing arguments. Section 3.5 discusses some aspects related to ownership, and Section 3.6 presents some empirical evidence. Section 3.7 concludes.

3.2 DEFINITION AND CHARACTERISTICS OF SCIENCE PARKS

Various definitions of science parks are found in the literature, probably because there are many terms that describe similar type of developments. For example, the concepts technopolis, research park, business park and technology park are all used to describe variations of science parks (Gavrea, 2011: 11). Some scholars argue that all these terms mean different developments and consequently will have different definitions and characteristics (Stockport, 1989). However, for simplicity, in this report all developments of this nature, even if they are not exactly the same, will be referred to as science parks.

One of the most recent definitions of science parks was put forward by the International Association of Science Parks (IASP) (2002) :

> *"A Science Park is an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a science park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities."*

The Association of University Related Research Parks (AURRP) (1998)[20] argued that the definitions of science parks vary as much as the individual parks themselves, nonetheless in general terms most science parks contain the following features:

- A real estate development;
- An organisational program of activities for technological transfer;
- A partnership between academic institutions, governments and the private sector.

Chan, Oerlemans, and Pretorius (2009), as well as the United Kingdom Science Park Association (UKSPA) (1986) further identify four general characteristics of science parks.

- *Clustering:* This means that similar firms in the same area are inclined to cooperate and form groups that would complement each other. Firms located in the science parks are geographically closer to each other than firms located outside the park. This is usually referred to as geographical concentration[21] which enables independent firms to exchange knowledge, information and technological expertise through efficient networking. This is possible because of close proximity to each other.

[20] AURP fosters innovation, commercialisation and economic growth in a global economy through university, industry and government partnerships

[21] Which is referred to earlier in Section 2.3.2 , in the context of the important role of knowledge networks.

- *Academic-industry link*: The core idea of any science park is the transformation of scientific knowledge into technological innovation. For this to happen there must be formal operational links between the science park and higher education institutions (HEIs) or research institutions. This link, as stated by Chan et al (2009), may have 5 different forms, namely:
  - ► Transfer of people such as key personnel, founders of the firms, staff to be employed by the firms;
  - ► Knowledge transfer through collaboration with students and researchers from HEIs;
  - ► Development of contracts, analysis, design, evaluation, testing, etc.;
  - ► Access to the facilities of the university;
  - ► Establishment of new firms through which researchers from the HEIs can transform their research into reality.

- *Management function*: One of the key management functions of the science park is to promote the transfer of business skills and technology to the firms located on the grounds of the science park. Westhead and Batstone (1999: 132) pointed out that in order to create effective links between the resources and facilities of HEIs and tenants, science parks should improve their managerial function. Through this function business skills and technology transfer takes place between the on-site organisations. Efficient management is also a dynamic process of setting objectives, planning to achieve them, continuously monitoring progress and introducing remedial action whenever an objective is threatened. Efficient management requires a sympathetic environment that minimises all obstacles and attends to challenges.

- *Knowledge flows*: Clustering or geographic concentration will facilitate knowledge transfer inside of the park due to lower communication cost. A science park promotes the establishment of businesses that are based on knowledge and these businesses are usually located in the science park. Two main types of knowledge transmission were identified in the literature namely unintended and intended transmission. When the exchange of knowledge happens under circumstances whereby individuals willingly exchange knowledge with other individuals or organisations, intended transmission occurred. On the other hand, knowledge that was exchanged unwillingly or to persons and firms other than those intended, usually refers to "knowledge spillover" (Chan et al, 2009). When firms form networks inside the science parks, the intended exchange of knowledge occurs through the use of direct connections. Knowledge spillovers, on

the other hand, are controversial. By investing in R&D firms unintentionally reveal their knowledge to other firms that benefit without carrying any costs (free rider effect)[22].

3.3 EVOLUTION OF SCIENCE PARKS

When considering the historical development of science parks around the world, it is possible to classify it in three generations as suggested by Vanhoudt (2006).

3.3.1 First generation science parks.

The first generation of science parks dates back to the 1950s and is characterised by science-push developments because in that era it was relatively easy for academics to become entrepreneurs.

The first park based on science was established in the 1950s in the USA (Kanwar and Daniel, 2008: 2). This park, named Silicon Valley, is regarded as the oldest functioning science park. Historically science parks where nothing more than "...physical spaces located near or on university campuses where the research and development laboratories of multinational firms were established" (Bigliardi, Dormio, Nosella, and Petroni, 2006: 291). The goal of these regional initiatives was to promote collaboration between the academia and the industry given that the former possessed a much wider range of knowledge than the later. Knowledge was considered to be the key ingredient to stimulate innovation.

Over time (due to the flow of information) new firms saw the potential advantage of collaborating with universities and began to position themselves near HEIs. Doing so was not difficult because most of the founders of these new firms were connected to the research laboratories or HEIs. As a result, a new stream of science parks emerged with the objective to exploit new collaboration models between industry and academia, similar to those that already existed between public and the private R&D facilities (Bigliardi et al, 2006: 292).

In Europe science parks became popular during the 1970s. In 1972 the first science-based park was established at the Cambridge University and logically it was named the Cambridge

[22] This is an example of a positive production externality (Black, Calitz and Steenkamp, 2008:36).

Science Park. Vedovollo (1997: 494) identified two main reasons for the establishment of science parks in the UK. The first reason was the fact that financial support from the government to the British HEIs decreased dramatically during the 1970s and 1980s and universities had to find other sources of finance. The second reason was the fact that the industrial sector in Britain was lacking technological dynamism. By exploiting the technological and scientific resources offered by HEIs, it was believed that industrial performance would improve significantly. Furthermore, at that time the primary industries[23] in the UK were going through a major crisis.

With the increasing importance of industries such as microelectronics, ICT and biotechnologies, reindustrialisation programs became a possibility, especially in those areas where old abandoned factories were located (Vedovollo, 1997: 494). The idea of creating a territorially enclosed environment for firms and universities through a science park and promoting their close cooperation was seen as a partial solution to these problems. As a result currently there are more than 50 established parks across the United Kingdom (UKSPA, 2010). Till today most British science parks are examples of strong partnerships between multinational companies and HEIs.

3.3.2 Second generation science parks

The second half of the 1980s was characterised by market pull developments where high-technology zones which promoted intensive R&D were quite popular. Most of the science parks in China and Japan are based on this principle. The first science park in China was established in 1988 in Beijing (Macdonald and Deng, 2004: 13). China, in particular, created 53 parks. By introducing various incentives the number of high-tech firms in these science parks increased significantly (Hu, 2006: 80). This, in turn, encouraged technology transfer through industry-academy collaboration that positively impacted on economic growth and regional development through factor accumulation.

The boom of science parks in Japan happened during the latter half of 1980s and by 1997 there were 158 parks were registered in the country. Local authorities in Japan undertook the responsibility of administering the science parks, given their trust in regional economic development through innovation by small firms. This boom in science parks in Japan can be

[23] These include steel, iron, fabrics, textile and other industries.

attributed to specific policies implemented in the late 1980s to early 1990s by the government on national land development (Fukugawa, 2005: 382). The objective of land development polices was to move high value-added industries out of big cities to rural areas.

3.3.3 Third generation science parks

In the second half of the 1980s science parks started to become more market orientated and cluster driven. The objective of this dynamic urban development was to create significant knowledge spill-overs that would benefit a wider population socio-economically and culturally.

Third generation science parks are modern parks that are often located in urban areas and based on strong linkages between the HEIs, industry and the government (local, regional or provincial). These science parks are highly specialised, promoting innovation at a global level and are also aimed at the development of entire communities (Martínez-Cañas and Ruíz-Palomino, 2011: 18). Put differently by Bigliardi et al. (2006: 293), third generation science parks have a developmental role aimed at increasing technology transfer at a regional level. This additional role was aimed at creating value added at regional and local levels by promoting the culture and competences of technological innovation.

During the 1950s up to the 1970s the models used for innovation where linear (the science-push and demand-pull models) but from the 1980s onwards they became more complex and dynamic with the inclusion of complex feedback systems of knowledge from HEIs into technological innovation.

3.4 ECONOMIC APPRAISAL OF SCIENCE PARKS

This section focuses on the reasons behind the establishment of science parks as well as on some arguments against.

3.4.1 Rationale for the Establishment of Science Parks

In recent years science parks are favored by governments and many institutions, including provincial and local governments, companies, HEIs, and others. These different role players

may have different reasons for supporting the establishment of science parks (Bigliardi et al, 2006: 296). Some of the reasons are related to:

- *Positive external impact of geographic concentration:* The notion of geographic concentration (referred to as clustering in Section 3.2) was developed by Marshall (1920) who argued that geographic concentration will generate external effects through localization and agglomeration. In the case positive externalities the marginal social benefit exceeds the marginal social cost (Black et al, 2008). Koh, Koh, and Tschang (2005: 237) summarise Marshall's theory of external economies as follows: "...localisation of skills, specialised materials and inputs, and technological know-how generates cost reductions for individual firms and increases returns to the region as a whole". Geographic concentration (Porter, 1990) is a situation where firms from the same industry are concentrated in the same geographical location. He argues that firms will be more competitive because they are in close proximity, which in turn will stimulate innovation.

- *Seedbed for technological development and innovation:* Felsenstein (1994: 94) refers to science parks as seedbeds for innovation and incubators for growth and development of small high-tech firms. In this case it is argued that universities will encourage innovation leading to new processes and product development by transferring knowledge to these firms. According to Westead and Storey (1995) science parks offer an important environment as a catalyst incubator where academic ideas are transformed into innovation leading to the development of new processes and products. In other words, the rationale behind the establishment of science parks is to stimulate innovative behaviour of small high-tech firms that are located inside the park.

- *Collaboration between the academia and entrepreneurs:* Storey and Tether (1998: 1038) claim that a science park can assist academics at HEIs to communicate and commercialise their ideas and to turn them into reality by using the facilities and advanced technologies offered at the park. It is expected that entrepreneurs and academics will collaborate to insure the sustainability of the park and facilitate the beneficial exchange of knowledge, technology and experience between the two sectors (Vedovollo, 1997: 492). Hu (2006: 76) similarly illustrates the importance of academia–industry links by saying that having

both sectors in the same physical environment will promote knowledge spillovers which will benefit the firms as much as academia.

- *Development of small and medium high-tech firms:* Guy (1996: 56) states that science parks can provide infrastructural support as well as technical and administrative support for small and medium high-tech firms. This support is particularly important for struggling new firms to enter the market of high competitiveness. Science parks can thus provide a strong support base for newly established high-tech firms. The Beijing Zhonnuancun Science Park, established in 1988, is an example of a successful park where the proximity to top Chinese universities and research institutes led to the establishment of world leading companies such as Lenovo, a computer and telecommunication company (Helmers, 2011).

- *Reindustrialisation:* Governments believe that science parks can contribute to the re-industrialisation of an economy as well as the development of a regional economy. This is exactly what happened in the industrial (See Section 3.3.1) sector of the UK. Koh *et al.* (2005: 219) argue that science parks are catalysts that stimulate economic growth and especially regional development. Hansson, Husted and Vestergaard (2005: 1039) similarly identify the creation of a science park as a political instrument hat ideally caters for reindustrialisation and regional development.

- *Higher economic growth over the long term:* Neo-classical growth theory argues that policy intervention may not sustain economic growth in the long run. When factor accumulation occurs due to policy intervention, it is believed that economic growth will only continue to the point where policy benefits are exhausted (Hu 2006; 81). In contrast, Marshall (1920), Romer (1986) and Arrow (1962) extended the theory of external economies into what became known as the MAR[24] theory. The argument is that geographically concentrated knowledge spill overs can result in increasing returns to investment and provide sustainable growth in the long run (Hu 2006; 81).

[24] MAR theory incorporates the dynamic aspect of external economies of scale and is based on the assumption that "…learning and knowledge spill-overs take place within individual industries" (Junius, 1997: 3)

3.4.2 Argument against Science Parks

Despite strong arguments in support of science parks, there are also some reservations as briefly referred to in the following paragraphs.

- *Performance measurement:* One major critique stems from the fact that science parks do not have a single clear definition (Bakouros, Mardas and Varsakelis, 2002: 125). As a result, it is difficult to measure its contribution to the economy in real terms. Bigliardi et al (2006: 489) identify various techniques which can be used to measure the performance of science parks. These include financial criteria, indicators related to innovation and Social Accountability Standards[25]. Formal science park performance measures have not been developed as yet and because science parks evolve over time and acquire new characteristics its measurement becomes even more complex (Bigliardi et al, 2006: 491).
- *Geographical proximity not a driving force:* The argument exists that geographical proximity between industry and academic institutions in the science park contributes very little to technological progress in the form of innovation. This critique was raised by Massey, Quintas, and Wield (1992) and they claimed that the majority of science parks were nothing more than prestigious real estate developments where insignificant innovation took place (Bakouros et al, 2002: 124). In other words, the geographical proximity between partners was not the driving force behind the formation of strong formal university-industry links.
- *Weak Academia-industry links:* Westhead and Storey (1995: 352) argued that despite the fact that firms locate themselves in a science park to be close to universities, the links between industry and university were not that strong. Löfsten and Lindelöf (2002: 864) also conducted a study on science parks in Greece and found that formal university-industry linkages created by geographical proximity did not play a crucial role in the development of science parks. Rather the value added through informal and human relations links seemed to be much more significant. In other words, the existence of informal links between academia and industry rather than formal links is important for the successful implementation of science parks.
- *Weak contribution to employment creation*: Another critique argued by Storey and Tether (1998: 1044) is based on European evidence where science parks were found

[25] Social Accountability Standards were established by non-government organisations with an objective to ease the flow of information and its transparency in the market place (USAID, 2007: 1).

to make a very small contribution to the creation of employment. However, as argued by the European Commission (2002) the employment creation becomes significant in the long run especially for the surrounding area of the park.

To conclude, due to the difficulties of measuring the performance of science parks and its contribution to the economy, science parks are regarded by some as an ineffective policy instrument for promoting innovation, employment and the development of high-tech industries.

3.5 SCIENCE PARK FINANCING

Science parks are mega-projects that require large financial investments. When it comes to park financing and management there are three key role players, namely the government (including development agencies), the private sector and HEI which can be either publicly or privately owned. As stated by Wallsten (2000: 4) the majority of science parks obtain some sort of subsidy from some or other government institution. Even parks owned by the private sector usually receive some government support, in the form of property, infrastructure, public services and/or some tax incentives. The internalisation of the positive external effect[26] of science parks (as discussed in Section 3.4.1) provides the rationale behind public subsidisation.

3.5.1 Type of ownership

There are various ways in which a science park can be financed. This will largely depend on the type of science park and also logically on the capacity of the government to contribute towards its financing. Allen (2006) discusses the various types of science parks according to whether they are pure publicly provided, or privately or though some other means.

- *University-based:* These science parks, commonly developed in European and other developed countries, are entirely owned and managed by a university. A university that initiates a science park development will incur a high initial capital outlay to provide for the required infrastructure. It is logical that the type of university that can initiate this type of project must either be very well established, or must have strong government support,

[26] See Section 3.4.1 on the positive external impact of geographic concentration.

or its internal financial situation must be strong (Allen, 2006). A good example of a science park under university control is certainly the Cambridge Science Park referred to earlier in Section 3.

- *Government-owned:* These parks are initiated, financed and managed by a provincial, local or regional government, sub-department of the government or a development agency. Allen (2006) argues that this type is not generally recommended because most governments are driven by political objectives that may result in rent-seeking and bureaucratic failure.[27] Despite this valid critique many science parks are government-owned. For example, most parks in Asia are government-based and they are well-known for their successful management. Yanglin Agricultural Technology Park in China is an example (Allen, 2006).

- *Privately financed:* It is argued that in practice these types of parks are generally the most successful mainly because they are managed under strict business guidelines irrespective of whether it is a non-profit-organisation, a company limited by shares or any other business-like form (Allen, 2006). These parks are often found in highly developed countries with well established and functional private sectors. An example is the Manchester Science Park in the USA.

- *Non-profit foundation:* Science parks financed by non-profit foundations are occasionally found in practice. These parks may have tax advantages and are normally supported by various types of government grants. However, because it is not run under a business scheme there can be significant tax disadvantages, especially if sometime in the future the legal system of the park is expected to change. This type of science parks is rare. Akronen Science Park an example of such a park. It is situated in Sweden is owned by a non-profit association with more than 90 members.

It is clear that where the private sector is strong, such as in well developed countries, most science parks are financed through private sector investment. In countries such as in Asia with strong government institutions science parks are provided publicly and financed through public investment. The question arises here, what about countries that have a weak developed

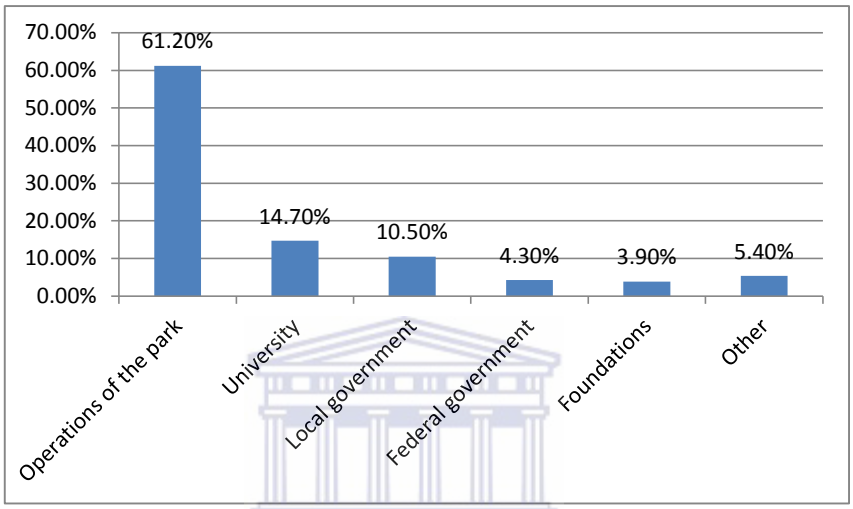
[27] Bureaucratic failure normally results in overspending and overprovision of public goods and services. Rent-seeking relates to artificially created rent form government protected monopoly power and may result in income and wealth transfers Black, Calitz and Steenekamp 2008: 76-79).

private sector together with a seriously fiscally constrained public sector, like most African countries? How should these countries go about to finance their science parks?

3.5.2 Financing of North American science parks

An interesting example of the sources of funding for science parks in North America is provided by Battelle (2007: 9).

Figure 3.1 Sources of funding for Science Parks in North America



Adapted from Battelle (2007: 9)

It is clear from the figure that the major source of funding comes from the park's own operations. Battelle (2007: 10) also indicates that the majority of science parks in North America have successfully generated retained earnings in the first 5 years of their operation. About a quarter managed to retain about 10 percent of average annual earnings, while about 48 percent failed to retain any earnings in the first 5 years. This result is quite shocking, given the fact that most parks normally rely on the earnings of the first 5 years to further finance their envisaged operations.[28]

Figure 3.1 also shows that government institutions (local and federal) are the second largest contributor to the financing of science parks. Universities as HEIs follow closely as the third largest contributor. Similar results would be expected for most other developing countries given the fact that most science parks in these countries are the result of government

[28] This is especially relevant in the case of Mozambique. (See Chapter 5.)

strategies. Lastly, international donors and foundations (USAID, Development Finance Institution, European Investment Bank, etc. contributed the smallest portion towards the financing of science parks in North America.

The relevance of this example to the case of Mozambique will be referred to in Section 5.3.

3.6 EMPIRICAL EVIDENCE

There is quite extensive literature that analyses different aspects of science parks and presents interesting empirical evidence. These findings are important for countries like Mozambique that still are in the early stages of the establishment of science parks. Finland, India and China were found to be interesting examples. Firstly, Finland is one of the key supporters of the establishment of science parks in developing countries, also specifically in Mozambique. In the same way as Finland, India also promotes science parks in developing countries, given that after decades of investing in these projects the country is reaping significant benefits from its science park projects. Lastly, China provides evidence of science parks that cannot be ignored. Not only is it the country with the largest number of science parks in the world, but it is also a country that has shown extraordinary success in transforming itself into a knowledge-based economy.

3.6.1 Finland

There are 40 science and technology parks in the country. Most of the science parks in Finland were established by the Finnish Science Park Association, Tekel, and the International Science Park Association (IPSA) as limited liability companies. Most of the studies on science parks in Finland focus on its impact on innovation (referred to as seedbed of innovation in Section 3.4.1) and the establishment of small high-tech firms. Based on the hypothesis of seedbed of innovation, Squicciarini (2009: 171) conducted a study on science parks in Finland[29]. The idea of seedbeds of innovation was developed by Felsenstein (1994: 93). With seedbed he refers to "…a nurturing process that eventually creates an environment for growth" or simply "conditions created to promote innovation".

[29] Squicciarini (2008) mentioned that this data was obtained from the Finish Science Park Association.

Squicciarini (2008: 185) makes some conclusions based on the evidence from science parks in Finland[30]. There is a possible existence of first mover disadvantage. This means that firms that were established first in the park will make their mistakes and firms that were established latter will follow in their footsteps and avoid the same mistakes. Therefore, it seems that in the case of newly developed firms it will be relatively easier to achieve the objective of creating a seedbed of innovation in comparison to pioneer firms.

In addition, it is argued by the same researcher that knowledge spill-overs contribute to the sustainability and success of science parks.[31] At the centre of this lies the notion of knowledge spillovers. Unfortunately, as pointed out by Squicciarini (2009: 171), some knowledge spillovers are not beneficial to other firms but only to the producer of that knowledge. This phenomenon is referred to as weak appropriability, which basically means that some knowledge is so integrated into the culture of an individual organisational culture that it is almost impossible to extract it and apply it to different organisations (Cassiman and Veugelers, 2002: 1170). This implies that there is no positive external impact. This means that knowledge spillovers will only be beneficial if they have strong appropriability.

It is also meaningful to refer to a specific science park in Finland. Turku Science Park is one of the largest and fastest growing parks in the country with more than 300 established firms and organisations, over 13 500 employees and 25 000 students (Kouvonen, 2007: 8). This science park is privately-owned and its objective is to act as a mediator between academic institutions, industry and the private sector. It is a good example of a successfully established science park. It is a hub of long-term innovation and knowledge distribution. By creating strong linkages between university, industry and public sector this park has benefited greatly from joint resources and expertise. Its mission is to create innovation by transforming university knowledge into high-tech innovative products and services. The key focus of this park is on ICTs, with the development of software, electronics, telecommunications and biotechnology with development of drugs, diagnostics and functional foods (Kouvonen, 2007: 8).

[30] Finland's science parks is important for this study, given that the Finish Government is one of the key supporters of science park establishment in Mozambique.
[31] See Section 3.2 referring to the fact that knowledge spill-overs can be controversial.

3.6.2 India

India is another country that showed significance progress towards the development of a knowledge-based economy. The High Commissioner of India in Mozambique claims that investment in science parks in India which were initiated more than 20 years ago, was a policy approach that greatly benefited the country (AllAfrica, 2010). As a result more than 20 parks have been established in India. Vaidyanathan (2007: 298) claims that science parks have indeed contributed to the establishment of India as one of the leading providers of software in the world. Institutional support played an important role in this achievement. The Indian government introduced various fiscal incentives that created a favorable environment not only for foreign investors but also for private Indian investors.

Vaidyanathan (2008) conducted a study on science parks in India. He found that the government played a crucial role in the establishment and further development of the parks. However, not all parks in India are pure public. Recently parks on software development were established through cooperation between the private and the public sectors. Some of them are even fully privately-owned.

Most science parks in India have biotechnology and information technology (software development) as their primary activity and have adopted strategies to promote export-orientation (Heshmati, 2007: 5). Especially in parks that develop software, export processing zones (EPZs) are very popular, given the intention of the government to produce computer software for export purposes. Lucknow Biotech park, established in 2003, is known for its revolutionary discoveries in the area of biotechnology.

Strangely enough, unlike most science parks around the globe, science parks in this country have no links with universities or HEIs. Instead Indian science parks have adopted a strategy of cooperating with other science parks around the world. For example, science parks in India provide technical services for Ebene CyberCity in Mauritius. They also have strong social networks with Silicon Valley Science Park in the USA. This weak industry-university link is in accordance with the research by Löfsten and Lindelöf who mentioned the importance of informal and human relations links (See Section 3.4.2).

Another important factor that largely enhanced the successful establishment of science parks was the availability of highly skilled labour. Many Indians migrated to the USA and other

advanced parts of the world to obtain the necessary education, skills and also to establish important social networks. They returned to India to establish themselves as academics and entrepreneurs. There are however, factors that constrain the efficient functioning of science park projects in India, such as inadequate infrastructure and brain drain.

3.6.3 China

By 2004 the number of science parks in China increased to more than 100 parks, national and provincial. Some of the largest parks (such as the Zhongguancun science park) were established by the International Science park Association (ISPA) and the International Science Park Administration Committee (SIP).

According to the second generation of science parks (See Section 3.3.2) most science parks in China were based on high-technology zones. It was argued that the establishment of small firms based on high-technology inside the parks which in turn will be located in rural areas, would positively impact on the regional economic development of the country (Tan, 2006: 828). As explained in Section 2.2.4.4, non-linear models can play an important role in regional innovative systems.

Small high-tech firms in the park benefit from various fiscal incentives such as lower taxes, access to various intellectual resources provided by universities or HEI in the park, as well as from the experience of multinational firms with which small firms are also expected to create inter-firm linkages (Wright, Liu, Buck and Filatotchev, 2008: 132). It is evident that the key objective of the government with the establishment of science parks was to transform the economy to a technology driven knowledge-based economy (Fang and Xie, 2008: 101). Through the science park projects important networks were created with foreign investment firms. Also increase labour productivity was experienced across all parks.

Hu (2006) investigated the impact of science parks on regional economic development in China. Since the early 1990s there was a significant increase in the rate of regional inequality in China. Big cities showed high economic growth while small cities in rival areas remained underdeveloped and poor. Hu (2006) used empirical analysis to determine whether science parks have contributed in any way to the existing inequality of the country. This study revealed that the establishment of science parks only partially contributed to regional economic development. However its significance was too small to positively impact on the

regional inequality of a country as a whole. Moreover, it was found that the use of neo-classical economic growth instruments (such as preferential policies that attracted large number of investors, which lead to fast factor accumulation) was the key driver behind the establishment of science parks in China. Thus a major lesson learnt from the Chinese science parks is that to attract FDI to a science park, government should introduce complimentary incentives and supportive fiscal policies.

In conclusion, despite the evidence of the success of science parks projects in these countries, it is suggested that before imitating the specific models used in these countries, policy makers from other countries should conduct a through investigation and consider the relevant aspects in the context of their specific countries. It is clear that governments will have to play a stronger role in developing countries than in a country like Finland.

3.7 SUMMARY AND CONCLUSION

This chapter illustrated how science parks can provide an important vehicle towards the development of a knowledge-based economy, by providing the necessary knowledge networks which will stimulate innovation and enhance the transfer and diffusion of technological change.

Different terminology are used to describe various types of science parks, however they have similar features: clustering, academic-industry linkage, knowledge flows and a management function. Science parks developed from first-generation science-push models, to third generation models which are more cluster-driven and market oriented. Various arguments were stated in favour of the development of science parks, the most important relating to geographic concentration, collaboration between academics and entrepreneurs, the fact that they can be seedbeds for innovation and technological development and promote the development of small and medium high technology firms. Science parks can also play a role in re-industrialisation and in regional economic development. Some arguments against science pars were also raised, the most important relate to the complexity of performance measurement, weak academic-industry linkages and contribution to job-creation.

Science parks can be fully owned by universities or by governments or they can be fully private. Most science parks are in some way or another supported by governments because of important external effects. Empirical evidence were presented on some aspects related to science parks in Finland, India and China and important lessons could be derived especially for a developing country such as Mozambique that are in the process to establish various science park projects.

The financing of mega projects of such nature is however problematic. The government of Mozambique decided to establish the first science park in the country through a public-private partnership project. Chapter 4 presents a descriptive overview of some important aspects related to PPPs.

CHAPTER FOUR

PUBLIC-PRIVATE PARTNERSHIPS

4.1 INTRODUCTION

Public Private Partnerships is a concept that is extensively used in modern economic thinking (Susilawati, Wong, and Chikolwa, 2009: 2). The idea behind the establishment of PPPs is the creation of a long term mutually beneficial relationship between public and private sectors. JICA (2011) claims that private investors are responsible for at least 70% of the capital flows from developed to developing countries. The mere existence of PPPs proves that private investors have an interest in the provision of public services and it seems therefore logical for the two parties to cooperate and form closer partnerships. These private funds are however usually channelled into sectors such as infrastructure, health and education, thereby increasing employment possibilities and the technical capacity of these sectors which will, in turn, stimulate economic growth and the general welfare of communities.

The aim of this chapter is firstly to investigate the possible types, nature of and rationale for the establishment of PPPs, which is covered in Sections 4.2 to 4.4. Section 5.5 focuses on specific factors that need to be taken in consideration to ensure the efficient functioning of PPP projects. The final section concludes.

4.2 DEFINITION AND EVOLUTION OF PPPs

4.2.1 Definition

There are many definitions of PPPs in the literature.[32] PPP is one of those concepts, the definition of which depends to a large degree on the specific country, institution or the projects it is supposed to be used for (Dwivedi, 2010: 11). For example, in the UK they are referred to as private financial initiatives[33] (PPI) given that initially these referred to financial

[32] Allen (1999: 7) identifies more than 6 definitions from different sources such as the Treasury Board Secretariat, the Ministry of Finance in the Czech Republic, UK Local Government Procurement Agency, the BC Ministry of Finance and other sources.

[33] PFIs are government policies which are aimed at increasing the involvement of the private sector in the provision of public services.

support from the private sector (Broadbent and Laughlin, 2003: 335). In Australia and New Zealand PPP projects are generally referred to as Alternative Service Delivery Models. In Canada where PPPs are particularly popular they are known as P3s (Vining and Boardman, 2006).

One of the most established definitions of PPPs was developed by the Commission of Public Private Partnerships[34] in their report of June 2001. It states that:

> *A PPP is a risk sharing relationship based upon a shared aspiration between the public sector and one or more partners from the private and/or voluntary sectors to deliver a publicly agreed outcome and/or public service.*

Fourie and Burger (2000: 3) define a PPP as "...an instrument and contractual partnership arrangement between the government and a private sector operator to deliver a good or service to the public..." Consequently, a true partnership between these two sectors is based on long term mutual agreements where all cost and benefits are shared according to agreed proportion.

4.2.2 Evolution

The existence of PPP dates back to 1652 when in the United States a partnership was arranged between the government and private entities to deliver drinking water to its citizens (Oregon Telecommunications Coordinating Council, 2003: 3). After almost 100 years, the notion of public-private partnerships is again referred to in the literature but in a different context. Benjamin Franklin, a former member of American Philosophical Society of Philadelphia, in 1742 speaks of the importance of a partnership between the public and the private sector for the development of science and technology (Feldman, Link and Siegel, 2002: 8). This is very interesting because currently PPPs are mostly used for infrastructural projects.

These types of partnership projects delivered better and more efficient public services through the combined capital resources and intellectual experiences between the two sectors. However, it was not until the 1980s that the concept of PPPs spread across the globe, in particular to the European Union, Central America, North America, South East Asia and Africa (Adam, Young and Zhihong, 2006: 384).

[34] This Commission was established by the Institute for Public Policy Research (IPPR) and this working definition can be found in their report on Building Better Partnerships (Tambini, 2000).

It is important to understand the evolution of PPPs. Traditionally there were two main economic agents: the state and the private sector. The government's rationale was mostly based on the notion of 'social justice' while the private sector was seen as the driver of economic efficiency (Burman and Parker, 1993). Therefore one of the main responsibilities of any state is the delivery of public or social goods and services to its citizens, while the private sector's main objective is to generate maximum profit.

Limited government budgets and repeated government failures often prevented or constrained the efficient provision of services to the public. Another reason was (and still is) the fact that governments' priorities are often based on political objectives rather than on the principle of efficiency maximization (Boycko, Shleifer, and Vishny, 1996: 310). For example, one of the main priorities by most governments is the protection of employment opportunities which may be lost when the aim is to enhance economic efficiency. Moreover, it was evident that governments' lack of managerial skills in managing government enterprises resulted in allocation and production inefficiencies and caused even slower service delivery. Consequently, state officials began to search for new methods of providing public goods and services by trying to involve the private sector.

Traditional neoclassical theory strongly relied on models of a competitive market as the centre of all conceptual frameworks. The main rationale was the belief that the most efficient allocation of scarce resources can be achieved when suppliers of goods engage in competition. This is believed to result in lower costs and more efficient delivery of goods and services to attract customers. Initially this was the predominant framework in the private sector where private firms practised competitive behaviour and where sound competition policies were put in place by the state to prevent the formation of inefficient oligopolies and to reduce horizontal integration of firms (Boycko et al, 1996: 311).

Subsequently, starting from the 1970s this framework initially used in the private sector became applicable in the public sector for the provision of public goods. This revolutionary engagement was initially referred to as "alternative service delivery" (ASD)[35] comprising of a

[35] As stated in Section 4.2.1 New Zealand and Australia still refer to most PPP projects as ASDs.

full set of different types of arrangements for the provision of public goods, that were initially provided solely by state enterprises (Boycko et al, 1996: 311). ASD included:

- Contracting-out of services;
- Privatisation;
- Public-private partnerships.

Contracting-out is when the private sector provides goods and services that were formerly provided by the public sector. The control and responsibility, however, remain in the hands of the public sector (Allan, 1999: 2). In the case of privatisation the public sector's involvement is minimal and can even be in the form of regulation of the post-privatised entity. In the case of PPPs, the public sector continues to perform a significant role in the partnership[36] (Allan, 1999: 2).

The fact of the matter is that both public and private sectors came to realise that different kinds of public services can be provided through different public-private combinations. It is argued that in partnerships the private sector also needs to consider its social responsibility (apart from mere profit maximisation) while the public sector needs to create the appropriate legal and regulatory structures. The public sector is responsible to provide the necessary institutional support, as well as the democratic and participatory process of decision making. Public agencies and private organisations can achieve mutual benefits from a strategic partnership that is characterised by trust, fairness, openness and mutual respect (Pongsiri, 2002: 489-490). For the public agency, the main rewards from a partnering with the private sector are improvement of cost-efficiencies and programme performance, better service provision and appropriate allocation of risks and responsibilities. On the other hand, the private sector expects to make a reasonable profit, have an opportunity for investment and to expand its business interests (OCSE, 1997).

The United Kingdom was one of the first countries to embark on a type of PPP known as a private financial initiative (PFI)[37]. PFIs were pioneered in UK in 1992 for the first time (Iossa, 2007: 2). It was initially concentrated in the transport sector and later applied to a wider range of public activities, such as schools and hospitals. Canada also began to use PPPs

[36] These three concepts are explained in more detail in Appendix 4.1.
[37] The difference between PPP and PFI is that the former is usually used with the objective to take advantage of private financing. PFIs are often used to implement projects of high capital intensity (CIPS, 2007).

round about the same time (1993), starting with bridges and roads and then moving to airports, water and wastewater treatment, medical facilities, recreation facilities and other public utilities (Bettignies and Ross, 2004: 136).

Today, many developed and developing countries have embarked on the use of PPP projects. Thomsen (2005: 3) gives examples of PPP projects in countries such as Bolivia, Afghanistan, India, Malawi and South Africa. Table 4.1 illustrates the magnitude of PPP projects around the world. It reflects the private sector's involvement in the financing of public sector goods and services.

Table 4.1 Private Sector Investment by sector: 1990 - 2003 (US Dollars)

Sector/Area	East Asia and Passific	Europe and Central Africa	Latin America and Carribean	Middle East and North Africa	South Asia	Sub-Sahara Africa	Total Per Sector
Energy	$71,522.90	$31,631.60	$118,841.60	$11,794.70	$20,258.50	$6,175.00	**$260,224.30**
Telecom	$53,243.10	$78,900.50	$171,390.10	$15,500.20	$21,436.10	$21,723.60	**$362,193.60**
Transport	$46,649.80	$4,719.60	$63,894.00	$2,425.50	$3,115.20	$2,748.90	**$123,553.00**
Water and Sewerage	$15,311.90	$3,327.40	$19,465.30	$1,236.50	$216.00	$229.80	**$39,786.90**
Total Per Area	**$186,727.70**	**$118,579.10**	**$373,591.00**	**$30,956.90**	**$45,025.80**	**$30,877.30**	**$785,757.80**

Source: Akintoye1, Kyaw1, Ngowi, and Bowen (2006: 6)

The data in Table 4.1 indicates that the majority of PPP projects were carried out in Latin America, followed by East Asia, the Pacific, Europe and Central Africa, South Asia, Middle East and North Africa and Sub-Saharan Africa. It also indicates that the sectors where PPP projects are more generally used are telecommunication, energy, transport and water and sewerage.

4.3 TYPES AND CHARACTERISTICS OF PPPs

4.3.1 Types of PPPs

The type of partnership selected for a particular project will depend on a number of factors (Navarro, 2005: 2). These include the amount of risk that the public sector is willing to transfer to private sector, the amount of investment that the private sector is putting on the table, the degree of decision-making transferred to the private sector, etc (Ministry of Municipal Affairs in British Colombia, 1999: 6).

There are six common types of PPPs found in the literature (Sadka, 2006: 5):

- Build-Own-Operate (BOO);
- Design-Build-Operate (DBO);
- Build-Operate-Transfer (BOT);
- Design-build-own-operate-transfer (DBOOT);
- Design-build-operate-maintain (DBOM);
- Finance-design-build-operate-maintain (FDBOM).

BOO is a type of partnership where the private sector finances, builds and operates the projects. Here the private sector also assumes full ownership of the project. A DBO, on the other hand, is a type of partnership where the partnership designs, builds and operates the project (Hall, Motte and Davies, 2003: 3). The government in this case is a sole owner of the project, unless it is a BOT or DBOOT where the private sector will be the owner of the project until the transfer of ownerships takes place. The DBOM is a type of partnership where the private sector designs, finances, operates and maintains the project for a specified period of time. The ownership in this case rests with the public sector for the entire duration of the project. Lastly, the FDBOM is a PPP that provides the finance, design, construction, operation and maintenance of a specific project for an agreed period of time (Pakkala, 2002: 10).

These types of PPPs are based on four main tasks that are necessary for the establishment of any project (Bettignies and Ross, 2004: 137), namely:

Task 1 - Define and design;

Task 2 – Financing of the capital costs;

Task 3 - Build the physical assets;

Task 4 - Operate and maintain the assets in order to deliver the product or service.

Given these tasks, the responsibility of the state is to decide which tasks will be performed by the private sector and which by the government. This is a very important decision to make as it has a direct impact on the efficient functioning of the PPP.

4.3.2 Characteristics of PPPs

Bettignies and Ross (2004: 138) refer to the following main characteristics of a modern PPP:

4.3.2.1 Extension of contracting-out

PPPs can be viewed as an extension of contracting-out[38] of the larger number of tasks listed in Section 4.3.1. Contracting out only includes task 3 or building of the physical assets for the project, while a PPP can and often does include more than one task. Historically, contracting-out was often assigned to the private sector. This is probably because empirical evidence suggests that the private sector can reduce costs or provide better quality services (Jütting, 1999: 8). The private sector is often more innovative and more flexible because it has an incentive to reduce costs in order to increase profits. The main reason why contracting-out reduces cost is generally related to increased competition in the market, because potential partners have to compete by reducing costs, increasing quality and by being more innovative in order to win the contracts. Another reason is the fact that contracting-out is incentive-based.

4.3.2.2 Bundling of responsibilities

A second key characteristic of the PPPs is related to the bundling of responsibilities. This implies that a single partner can be responsible for a number of tasks. For example, a partner may design the project, then also maintains, and operates it (Tasks 1 and 4 referred to in Section 4.3.1). The most important advantage of the delegation of these tasks to a private partner is the advantage of complementarities associated with the combined design, financing, construction and operation within one enterprise. The reasoning behind relates to the fact that a single firm will be driven by the incentive to minimize the lifetime cost of the entire project, by shifting costs to different stages which can only be done within one firm (Sadka, 2006: 9).

[38] Refer to Appendix 4.1 for a more detailed explanation.

Additionally, the advantage of technological complimentarily may also be recognised especially when allocating building and design (tasks 2 and 3, Section 4.3.1) to a single partner (Bettignies and Ross, 2004: 141). This is because a well-built project requires a good design.

4.3.2.3 Private sector financing

Another important characteristic of many PPPs is the allocation of a major part of the financial responsibility to the private sector (CIPS, 2007: 1). This is because many projects require extensive capital investment, for example for the construction of large buildings or the provision of infrastructure. PPPs are established by governments to secure the financing of these projects. This is particularly true for developing countries such as Mozambique which are often characterised by high public debt ratios as % of GDP and high aid dependence.

However, PPPs are also criticised on the grounds that governments can borrow at lower rates of interest than private sector firms (Sadka, 2006: 10). Consequently, governments use this strategy to create fiscal illusion, in which case taxpayers will think that their government is holding down on increasing public debt, but actually they continue to provide new and better services. Bettignies and Ross (2004: 140) however provide some counter arguments.

Firstly, there is no concrete evidence illustrating that governments can always borrow at cheaper rates than private sectors. To analyse the relative cost of the two, Bettignies and Ross (2004: 141) suggest that the following factors be considered:

1. "The credit-worthiness of the private borrower and the protections offered in its contract with the public sector partner;
2. The extent to which tax savings may come from other levels of government;
3. The degree to which the supply of funds to the public sector borrower is upwards sloping" (Which means that more funds will be available at higher interest rates).

Secondly, the presence of important complementarities is often found between financing and other tasks (maintain or operate for example). It is thus important to consider the full costs of performing those tasks rather than the financing of each on its own.

4.4 ECONOMIC APPRAISAL OF PPPs

4.4.1 Rationale for PPPs

Three key arguments for the use of PPPs are highlighted in the literature. These are explained in the following sub-sections.

4.4.1.1 Fiscal and Political benefits

The first motivation for government's engagement is that through PPP projects they can minimise government expenditures and/or slow down the rise in current public debt ratios (Vining and Boardman, 2006: 4). There are often political benefits to be derived from keeping capital expenditures off the government's official budget (Joulfaian and Marlow, 1991). Private sector financing channelled through PPPs can be viewed as additional resources available for the provision of public goods and services (Allan, 1999). This is an important advantage because it allows a project to go ahead even when public finances are not yet available for its implementation, which is often the case in developing countries like Mozambique.

However, it is important to emphasise that the underlying economic reality of an investment is not altered if it is not on the books. In other words, no matter how a project is financed, the government or users ultimately have to pay for its construction and operation (Quiggin, 2005). By using PPPs, governments can spread the cost obligations over a longer time period. As this mainly affects the timing of the payments and is not likely to reduce costs, the rationale is rather weak. In some cases, though, time shifting can be justified on the grounds of economic efficiency and effective distribution of resources (Vining and Boardman, 2006: 2). For example, it is justifiable for most infrastructural projects that are expected to operate for long periods and for many generations to come.[39]

4.4.1.2 Cost-superiority and production efficiency

The second motivation identified by Fourie and Burger (2000: 4) is based on evidence that the private sector can provide services and infrastructure at lower cost than government due to economies of scale, better incentives, more experience and a relatively greater ability to

[39] In the case of a long-term asset, such as infrastructure, should the real return on the investment in excess of the marginal cost of finance, the combinaiton of debt and a performing assest, will actually increase the welfare of the next generation (Black et al, 2008:267.

innovate. Private sector firms driven by profits have the incentive to push production and marketing processes to their most efficient and cost-minimising limits by practicing good management. Furthermore in a competitive environment private sector firms are forced to be competitive in order to survive. There are multiple sides to the argument of production and cost-superiority efficiency (Vining and Boardman, 2006: 3). Private sector firms are more specialised, may have more experience and can reap the benefits of learning and of economics of scale.[40]

Private sector firms that provide infrastructure may be global in scope. In contrast, governments usually have less specific experience or expertise with the relevant technology or activity. This cost difference is likely to be especially relevant in the case where provincial and municipal governments are supplying the services. Any such cost advantages may be significant in the design and construction phases of a project. Another cost-superiority argument is that the private sector is driven by incentives to minimise costs (Jensen and Meckling, 1976: 5). Because of cost-reduction incentives, the private sector may have more cost-efficient operations, such as procurement policies and better project management skills, while holding scale constant. These relative advantages are likely to be more evident in the dynamic aspects of a project, such as, for example, a greater willingness to alter project specifications or to utilise new technology.

A PPP can also improve production efficiency (Fourie and Burger, 2000: 5), which relates to the ability to produce at minimum long-run average costs. As mentioned earlier, PPPs can exploit the existence of economies of scale (Bettignies and Ross, 2004: 139). It is argued that governments usually do not have enough work to generate the volume of business required to minimise unit costs, whilst private sector firms are mostly in a position to reap the benefits from large-scale production which bring down average operating costs.

The final argument is that monopolistic state-owned enterprises are particularly prone to X-inefficiency. The concept of efficiency embodied in PPPs is of a dynamic nature, where it refers to the "capacity of the productive system to innovate and adapt to changing external circumstances" (Deakin and Michie, 1997). This requires co-operation between the public institutions and the private sector based on sharing of authority, information, planning,

[40] When a firm enjoys economies of scale, the firm's average cost declines over time with an increase in output. When there is learning, the average cost curve shifts downward. "As the production process becomes better organized and workers gain familiarity with their jobs, labor requirements fall…" (Quijano and Quijano, 2009: 44)

decision-making, financial risk, responsibility and accountability over a extended period of time. It is agreed that technical efficiency considerations are the best normative argument for PPPs. However, Deakin and Michie (1997) warn that when it comes to PPPs the private sector is more concerned about increasing its profits rather than decreasing public sector costs.

Fourie and Burger (2000: 5) also argue that there are circumstances where the private sector efficiency argument may not hold. This is because the problems of bureaucratic behaviour often found in the public sector may be present in the private sector as well, especially in a large corporate environment. Nevertheless, because it is extremely complicated to establish the difference in efficiency between the private and the public sector empirically, researchers often rely on the theoretical basis of economic efficiency.

4.4.1.3 Risk sharing

The third rationale relates to the opportunity to reduce the risk, especially during the design, construction and operating phases of any project. Through the use of PPPs the public sector can reduce the risk associated with its financial exposure to construction and maintenance costs. (Hurst and Reeves, 2004: 380). The involvement of multiple partners would imply better allocation of particular risks to those partners who can manage them best, thus minimising the cost related to risk management (Allan, 1999).

Fourie and Burger (2000: 5) also refer to the issue of risk-taking by private sector firms. "Only because the continued health and survival of the firm is at risk due to seller competition and consumer freedom of choice, are managers sufficiently 'incentivized' to deliver maximum efficiency" (Fourie and Burger, 2000:7). Allan (1999) claimed that when private partners carry risks they would have greater incentives to perform at their best. They also have various performance-based remuneration arrangements which are rarely present in the public sector, but can be a significant incentive to stimulate improved performance.

Vining and Boardman (2006: 6) do not agree. They claim that it is not a strong normative justification as it does not reduce risk *per se*, it only transfers and spreads it more broadly. Usually, the private sector also has more expertise with sophisticated financial instruments and better access to financial markets that can spread risks to partners who can price and bear it efficiently. The private sector is also less vulnerable to political risk (including rent-seeking

activities) which is an extremely important advantage, especially in countries where corruption is rife.

4.4.2 Arguments against PPPs

There is a lot of controversy, both conceptual and practical, with regard to the use of PPPs. The following sub-sections present some arguments against PPPs.

4.4.2.1 Low Private Accountability

The most significant concern is private accountability with regards to the sector`s involvement in the provision of public goods and services (Engel, Fisher and Galetovic, 2007: 2). The argument relates to the fact that the private sector is always driven by profit maximisation while the public sector has the public interest as main objective. Put differently, PPPs tend to bring fragmentation of structures and processes which may lead to distortion of responsibilities and of accountability.

This is because each party loses some of its own decision making power in the PPP-structure. The problem also arises because of the fact that once the PPP is formed, it is considered to be the 'accountable body' for the project (Bovaird, 2004: 204). However, it is extremely complex to make the PPP the accountable body, because often there is no institutional framework to guarantee the complete independence of the PPP.

4.4.2.2 Less political control and decision-making

Public administrators, who are responsible for the establishment and implementation of public policies, also criticises PPPs on the grounds that they tend to weaken political control over decision-making (CUPE, 2008: 1). In other words, politicians fear that they will lose their power over decision-making. However, previous experience showed that politicians can better spread their vision of how public services should be provided with the use of PPPs (Zarco – Jasso, 2005: 7).

4.4.2.3 Reduced employment

On a more practical side, PPPs can negatively affect employment and conditions of employment (CUPE, 2008: 6). This is because partnerships have a tendency to negatively affect public payrolls and to decrease wages (Wang, 2006: 2). Some jobs may also be lost at the expense of cost-efficiency (See Section 4.4.2.2). Not surprisingly, trade unions often disapprove of the establishment of these partnerships because workers may lose their jobs when some public responsibilities pass on to the private partners (Bovaird, 2004: 207).

Unfortunately, many public sector workers have experienced that loss. On the other hand there are others who have successfully made the transfer and experienced the new working environment more rewarding.

4.4.2.4 Increased Prices

Communities fear that because the private sector is generally driven by profit maximising rather than the interest of the general public. Services that were previously provided entirely by the public sector were often under-priced with an objective to address some socio-economic challenges. On the other hand, once the private sector is involved in the provision of these goods and services, the prices of these goods and services are expected to be much higher even with appropriate price cap regulation (Sappington and Weisman, 2010: 228).

4.5 FACTORS DETERMINING THE EFFICIENT FUNCTIONING OF PPPs

There are a number of factors that can determine whether a PPP will fail or succeed. According to Wang (2006: 3) different partners will have different factors that they identify as important. For example, public administrators argue that it is important to define roles and responsibilities of each partner properly. Private sector partners, on the other hand, believe that a successful partnership should be based on fairness, risk sharing, openness and respect. All these criteria are however important for the successful functioning of a PPP. The following determinants seem to be the most important:

4.5.1. Comprehensive Needs Analysis and Feasibility Study

Before establishing a partnership for a particular project an analysis should be conducted to determine whether there is indeed a real need for this project. “A particular project must undergo a comprehensive needs analysis of basic services and infrastructure” (Farlam, 2005, iii). Thereafter, a feasibility study should be conducted that includes an investigation of the private provision in comparison to the public provision of the service, in terms of risk transfer, allocation between the partners, accountability and efficiency. A feasibility study should also incorporate the analysis of various financial models and reasons for a selection of a specific model (Farlam, 2005, iii). As recommended by the European Commission (2007: 63) a feasibility study is also “conducted to identify the potential market segments of a park as well as factors attractive to potential tenants”.

4.5.2 Choosing appropriate partners; clearly defined roles and responsibilities

This can be an extremely complicated process, but it is the starting point for a successful PPP-project. As stated by the NCPPPS (2006) there are cases where the lowest bid may not necessarily be the best bid. Skills, experience, professional reputation, a high level of technological expertise are some of the key factors that should be considered when selecting partners. In the initial stages of PPP implementation it is important to transfer responsibilities, roles and thinking within the public sector. For a PPP to succeed, the public agent must accept and acknowledge that the private sector will take on some of the responsibilities that were previously managed by the public institution.

The government´s role in the partnership is very different from the role of the private sector or non-profit organisations. It is important not only to transfer responsibilities but also to clearly define the respective roles of the government versus that of the private sector. It is important that government officials not only support, but thoroughly understand the PPP-structure and the advantages of having private partners (Wang, 2006: 2).

The government should be an active partner in the operations of the partnership. When the partnership is established some of the risks and responsibilities should be transferred to the private sector so that the true collaboration takes place. However, Wang (2006: 2) warns that there are certain responsibilities that cannot be passed on to the private sector. These include, for example, service delivery in sectors with high social significance such as health, education and social welfare (Abrahams, 2000).

It is also important that the private sector is fully aware of the risks and responsibilities related to the project. In other words, transparency is important. It is equally important to create an effective decision-making system that would facilitate the understanding and communication between the private and public sector.

4.5.3 Public-private sector complementarity

Abd Aziz, Hani and Musa (2007: 161) found that the essential quality of successful partnerships is that of complementarity, in which the strengths and weaknesses of each partner are offset against those of the other in generating developments that produce the best results. The notion of complementarity is further discussed by Pradhan, Ratha and Sarma,

(1990:101) where the public sector is considered complimentary to the private sector if an increase in investment (by the public sector) positively impacts the level of investment of the entire economy. Pradha et al (1990: 102), however, argues that many countries (like India), are faced with an issue of crowding out rather than complementarity. Crowding out occurs if an increase in the public investment leads to a disease in the formation of private investment (Chakraborty, 2007: 2). However, Chakraborty (2007: 2) argues in the case of Korea that even though private capital accumulation declines in the short run, the total investment of the economy can still rise under certain circumstances.

4.5.4 Organisational policy and detailed work plan

A successful PPP project should include two elements, namely an organisational policy and a detailed work plan (Wang, 2006: 1):

- *Organisational policy*

  A policy is a set of rules to guide management in making decisions to achieve a rational outcome. It can be regarded as a statement of intent.

  The organisational policy outlines the core values and rationale for a particular partnership. It will also establish non-negotiating good-for-all principles and regulations and identify the objectives that partners want to accomplish with this partnership. Additionally, organisation policy will identify the skills, resources and knowledge required for the success and the lifetime of the partnership

- *Work plan*

  A work plan proposes how an organisation should be structured to achieve the goals of the PPP. It consists of

  - A mission statement that spells out the organisation's purpose;
  - A set of goals and the strategies how to achieve them;
  - A business structure required to achieve these goals.

  A detailed work plan should be prepared with a lot of care and brainstorming by relevant experts beforehand. A detailed work plan will explain responsibilities, roles and the structure of decision-making of public and private partners. A work plan should explain the means through which disputes amongst partners will be resolved and this method should be incorporated into the original contract between partners (Agboli and Ememry, 2005: 9).

4.5.5 Sources of finance

According to Farlam (2005; iii) the most appropriate type usually depends on the type, magnitude and duration of the project.It is critical to plan which sources will be used for a specific project given its characteristics, industry and country. Izaguirre and Kulkarni (2011: 3) and the Asian Pacific Centre for Information and Communication Technology (APCICT) (2010) refer to the numerous sources of finance that can be used. These include private commercial banks, conventional corporate funding, public financial institutions, multilateral and bilateral agencies, private sector investors, FDI, international financial institutions, government-to-government funding etc.

The more common sources of finance are (Brigham and Davis 2004:

- Public financial aid. This is made available by the national or lower levels of government (municipalities), sometimes at a reduced interest rate;
- A long term bank loan to finance the capital layout, offered by one bank or a consortium of banks. Such a loan would require collateral. Bank financing may also be in the form of quasi-equity financing. It typically involves a mix of debt and equity. Investors can achieve gains through capital appreciation and interest on debt-repayment. No collateral is required;
- A short term bank loan, such as revolving credit. Only operating expenses can usually be financed with this type of loan. Collateral may be required, depending on the extent of risk related to the project;
- A government bond. Most of these bonds pay a fixed interest amount or coupon rate once or twice a year and the capital amount is refunded at maturity. These bonds are popular because the units are marketable at any time during the period of the bond, and depending on market interest rates, investors may enjoy capital gains (or losses).

However, EIC (2009: 1) points out that most PPP projects in developing countries are supported financially by multilateral developing agencies such as the World Bank, the International Financial Corporation (IFC), the European Investment Bank (EIB) and the Asian Development Bank (ADB). This may be one of the most important sources of finance in a developing country, such as Mozambique.

4.5.6 Institutional arrangement and regulatory framework

The institutional arrangements can be considered a key determinant of the successful implementation of a PPP-project. Institutional complexity with multiple role players and organisations from the public sector may undermine the success of the PPP. It is important that the respective responsibilities are made clear to each party and that the institutional structure is simplified (Allan, 1991: 30). Furthermore, procurement decisions for which the public sector is often responsible requires a level of commercial knowledge and experience that the public sector usually lacks.

There is no doubt that to have a successful PPP-project there is a need for a effective regulatory framework. Such a system is useful in helping partners to align their interest, reduce opportunistic behaviour and deal with market imperfections (Pongsiri, 2002: 490). Regulation is of particular importance in developing countries without which fairness, effectiveness and openness of the PPP-project could be compromised. However, as argued by Pongsiri (2002: 492) most developing countries lack sound regulatory frameworks that are supposed to control PPPs. There is a need for a control mechanism and accountability to be put in place by government authorities.

Strong institutional support can provide assistance to the structuring of effective transactions in the short term. Such support can be established in the form of a unit which would be separate from government institutions, or it may be part of it, but it is crucial that it should be independent and credible (Pongsiri, 2002: 489). Where necessary provide political guarantee should be provided for local and foreign investors (Farlam, 2005, iii). This is particularly important in case of a developing country where the risk of investing is higher than the developed country.

4.5.8 Transparency and accountability

It is also important that the private sector is fully aware of the risks and responsibilities of a certain project and that all the process are fully transparent. In other words, transparency is a critical factor for the success of PPPs Moreover, the issue of accountability as explained in section 4.4.2.1 should also be very clear to both the private and the public sector and ideally direct policies should be established to ensure PPP independence (Bovaird, 2004: 204).

4.5.9 Standardised PPP initiatives and database

The last recommendation given by HM Treasury[41] (2000) was that it is important to create a database with all successfully implemented PPP initiatives with all the relevant particulars. This will not only assist the future PPP initiatives but also reduce the need to "reinvent the wheel" (Allan, 1999: 3). Furthermore recent experience suggests that where possible PPP initiatives should be standardised (Allan, 1991: 30). Moreover, it was recommended that governments should prioritise when it comes to the areas where PPPs should be implemented.

4.6 CONCLUSION

Public Private Partnerships are important due to the fact that both public and private sectors realise that different public services can be provided through different public-private combinations. Some infrastructural and service delivery projects require huge capita investment which is problematic for governments in developing countries. This is especially relevant in the case of Mozambique where the government relies to a large extent on foreign aid to balance its budget.

The chapter distinguished between the types of PPP, which relate to what functions are assigned to the different partners. It also highlighted important features of PPP-projects. The following advantages were presented as arguments in support of PPPs: fiscal and political benefits, cost-superiority and efficiency and the sharing of risk. Arguments against relate to private sector accountability, loss of political control and power of decision-making, as well as reduced employment and higher prices.

Important factors that will determine the successful implementation of PPP-projects were identified of which the following are the most important: a comprehensive needs analysis and feasibility study; organisational policy and detailed work plan, choosing the correct partners, institutional arrangement and regulatory framework. A detailed investigation into these factors falls outside the scope of this dissertation, but should however be seriously considered by policy makers in Mozambique. The wisdom of using a PPP to establish a Science park is uncertain. On one hand, the fact that PPPs are not generally used to finance science parks may be due to its practical applicability. On the other hand, it may be due to fact that the

[41] Her Majesty Treasury (UK)

PPPs only really gained its popularity in the last decade and that the first initiatives to use it for the establishment of science park are only starting to emerge.

APPENDIX 1

Contracting-out is when private sector provides goods and services formerly provided by the public sector whereby the control and responsibilities remains in the hands of the former (Allan, 1999: 2). The private sector does not, under normal circumstances, take any participation in the decision making. On the contrary, in PPPs the decision making is shared between the two sectors as stipulated by the terms of the contract. Furthermore, in PPPs private-sector can often be a capital assets and service provider. When privatization is compared to PPPs, in the later the public sector continues to perform a significant role in the partnership, whereas, in the case of a privatisation, public sector involvement is minimal and can be in the form of regulation of the post-privatised entity (Allan, 1999: 2). Contracting-out, privatization and public-private partnership have one key similarity, namely the fact that in all of them "the public sector changes from being a direct provider of services to the public to being a procurer of services and, possibly, a regulator". For the policy purposes it is critical, however, to clearly define the PPP structure as it is the essential element and an essential condition for its success (Fourtie and Burger, 2000: 2). Farlam (2005: 2) summarises the key differences between the PPP, contracting-out (or public procurement) and privatization as illustrated in Table 4.1.

Table 4.2 PPP, Privatization and Contracting-out

	Public Procurement	PPP	Privatization
Definition	►Supply by the private sector of goods, works or services as defined by the public authority	►PPPs introduces private sector efficiency into public services by means of long term contractual arrangement. They secure all or part of the public service, call upon private sector know-how.	►Means transferring a public service or facility to the private sector, usually with ownership, for it to be managed in accordance with market forces and within a defined framework.
Main features	►Contracting authority establishes clearly what is to be built, how and by what means ►Invitations to tenders are accompanied by very detailed technical specifications regarding the type of work being produced ►The procurement process is short-term in nature and does not involve long-term occupancy of infrastructure assets, and thus does not lay emphasis on the operational phase of the project	►Contracting authority establishes the specifications of a project and leaves to the private sector the responsibility of proposing the best solution, subject to certain requirements ►Price is one of the many criteria in the evaluation of bids. A lot of emphasis is on the technical and financial capability of the bidder, financial arrangements proposed, and the reliability of technical solutions used ►Given the long duration of the concession period, emphasis is on the arrangements proposed for the operational phase.	►Privatization authority prepares the investment plan ►Involves transfer of ownership to the private sector ►Is generally a complex transaction with carefully designed contracts and a multi-stage competitive tender process ►Generally the public sector withdraws from management of the entity on privatization ►Almost all risks are born by the private sector

Source: Farlam (2005)

To summarise, PPP is not the same as privatisation or contracting-out. There are crucial differences in definitions and features of the three concepts. Consequently, a PPP should not be mistaken to privatisation or contracting-out.

CHAPTER FIVE

THE CASE OF MOZAMBIQUE

5.1 INTRODUCTION

Mozambique is a developing country in Sub-Saharan Africa that in recent years impressed the world with its economic growth and development despite its continuous dependence on foreign assistance and a high level of poverty. Significant improvements related to investment in infrastructure, institutional framework and skills development were observed, amongst others, in the agricultural, mining, electricity, services and telecommunication sectors.

The Government of Mozambique acknowledges the current trend in global information and communication technology and as a result has launched a number of ICT related polices and strategies in recent years. The objective is to create the necessary tools to take advantage of benefits that ICTs may offer, such as the creation of an enabling environment for the establishment of a knowledge-based economy. One of the policy tools selected to achieve this goal is the establishment of a first science park. As was explained in Section 1.1, the Government of Mozambique decided that this science park would be established through a public-private partnership project.

The aim of this chapter is to present an overview of the policies and measures that the Mozambican government has put in place to enhance the development of a knowledge-based economy. In section 5.2 the focus is firstly on policies to promote ICT development in the country and then on progress towards the establishment of the country's first science park. Section 5.3 focuses on the decision to use a public- private partnership project to establish the science park. Section 5.4 concludes.

5.2 THE ESTABLISHMENT OF A KNOWLEDGE-BASED ECONOMY IN MOZAMBIQUE

5.2.1 Background Overview

Over the last couple of years Mozambique has experienced sustainable economic growth and a reduction in the level of poverty through the implementation of stable political, economic and environmental strategies as stipulated by the 2005-2010 Action Plan for the Reduction of Absolute Poverty[42] (PARPA II) (OECD, 2008). The IMF (2008) referred to the developments in the country as "…one of Africa's most remarkable success stories. With a population of approximately 20 million, Mozambique is one of the most populous countries in the world (World Bank, 2009). The significant progress in the reduction of poverty in Mozambique, is illustrated by the fact that in 2001 about 70% of population lived below the poverty line and by 2009 that has been reduced to 54, 7% (IMF, 2011: 7).

Macroeconomic developments are particularly impressive. From 1993 the real GDP grew by on average of 8,1% p.a. with the exception of the early 2000 when heavy floods negatively affected real GDP growth (Conselho de Ministros, 2006). Economic forecasts predict that the GDP of Mozambique could reach a growth rate of 7, 8% in 2012 (Economy Watch, 2011).

This improvement in economic performance can partly be attributed to the development of some mega-projects in the country (Sonne-Schmidt, Arndt and Magaua, 2009: 1). Andersson (2001: 1) describes the following four key mega-projects in Mozambique:

- **Mozal aluminium smelter (Mozal)**

  This aluminum smelter accounts for about 60% of the exports from Mozambique. Mozal is also concerned about the development of the local community and as result created Mozal Community Development Fund. This fund supports small business development, education and training, health and infrastructure. The aluminum smelter created a significant number of jobs for the local population. About 90% of the employees of Mozal are Mozambicans (Mitsubishi Corporation, 2006: 10).

[42] PAPRA is a key policy tool used by the Government of Mozambique to reduce absolute poverty and to re-launch its economic and social development. PARPA was introduced in Mozambique in 2001 and is a five year plan for the reduction of poverty. PARPA II was implemented thereafter for the period 2006-2009 (IMF, 2007)

- **Cahora Bassa Hydroelectricity (HCB)**

  HCB is a hydroelectric plant that uses water from the Zambezi River to produce electricity. This plant plays a significant role in the country's exports, by exporting most of the electricity produced to South Africa (Scodanibbio and Manez, 2005: 977).

- **Temane and Pande Natural Gas Project (Sasol Project)**

  This project is a public-private partnership between South Africa (Sasol is the main shareholder) and Mozambique and the core business of the PPP is to produce gas for export to South Africa). Local communities benefit from this project in terms of employment and improved infrastructure in the area of the pipeline (Zimba, 2010: 1).

- **Nacala Development Corridor (NDC)**

  The NDC is a joint venture between the Mozambican, Zambian and Malawian Governments with its main objective to improve roads, ports, power, airports and tourism along the corridor. The project became operational in 2009 with the help of some major donors (African Development Fund, Japan International Cooperation Agency (JICA) and Korea's Exim bank (African Development Bank, 2009: 4).

Castel-Branco and Ossemane (2010: 6) estimated that the export of products by mega-projects such as aluminium, electricity and gas accounted for 71 percent of total exports from the country in 2007-2008. It is also estimated that over the next 10 years these 4 mega-projects will generate USD 7 billion in foreign direct investment, which is really impressive given that the current GDP in Mozambique is about USD 11 billion (Economic Watch, 2011). Therefore, it is clear that the mega-projects in the Mozambican economy, especially those related to infrastructure development are essential for the growth and development of the country. Furthermore, they can enhance the development of a knowledge-based economy because they use advanced technologies and high-technology skills.

For continued expansion of these mega-projects and successful implementation of pending mega-projects (such as the Maputo Iron and Steel Project, Corridor Sands titanium as well as the other science parks) the Government of Mozambique is committed to improve the transport system, especially the railways and harbours, the provision of energy together with greater transparency of the policy related to special tax allowances (OECD, 2008).

In contrast to these positive developments, very little progress has been experienced in the development of small and medium enterprises (SMEs), despite the fact that they are identified by most economists as a possible driving force for sustainable economic growth (MICTI, 2002: 7). The lack of linkages between SMEs and mega-projects also seems to be a

major challenge, because the largest part of foreign direct investment (FDI) is channelled to mega-projects (Roberts, 2000). This is an area where the science park can be expected to make a contribution in terms of the development of small and medium high technology firms.

5.2.2 ICT Development

5.2.2.1 Background overview

One of the objectives of PAPRA II is to promote ICT development in all sectors of the economy such as agriculture, health, education, roads, water and other infrastructure as well as sanitation and food security. According to the government (Conselho de Ministros, 2006: 6) ICT development is regarded as one of the key instruments that provides opportunities for improvement in all areas of development:

> "ICT will enable Mozambicans to access the benefits of worldwide knowledge resources, raise the effectiveness and efficiency of State institutions and their value to the public through provision of services, improve quality of governance and public administration, and help raise Mozambique to the level of a valued and competitive partner in the Global Information Society"

It has been globally established that ICT is a driving force for the establishment of knowledge-based economies and Mozambique needs to follow this trend if the country wants to participate in the world economy and take advantage of economic opportunities presented by the global economy.

Conselho de Ministros[43] (2006) identifies the following potential advantages of ICT development, which can be directly linked to a knowledge-based economy.

- Improve knowledge exchange in real terms;
- Promote and create networks between institutions, individuals and geographic regions;
- Introduce new channels for service delivery;
- Promote economies of scale;
- Promote transparency and openness;
- Promote open and multi-directional communication.

In the context of poverty reduction, which is the key objective of the Government of Mozambique (OECD, 2008) the promotion of ICT is important to improve the diffusion of

[43]The Council of Ministers of the Mozambican government

knowledge and ICT services. Additionally, ICT is critical to improve the access to regional and global markets and services on-line.

5.2.2.2 Recent developments

The development of Mozambique's ICT sector has undergone some major improvements in the last couple of years. For example, in the telecommunication sector the number of cell phone users increased from 3 to 62 per 100 individuals between 2000 and 2005 (Muchanga and Mabila, 2008). Similarly, the number of internet users increased from 1 to 7 per 100 individuals over the same time period. However, none of the equipment used by the ICT sector is manufactured in the country despite the fact that the majority of suppliers operate in Mozambique (Muchanga and Mabila, 2008). For example, none of the equipment used by the telecommunications sector is produced in Mozambique, but suppliers such as Alcatel, Ericsson, Siemens, operate in the country (UNECA, No date). Policy makers need to use this as a window of opportunity for local ICT development.

Furthermore, over the past ten years the government of Mozambique implemented a number of ICT related projects in the country such as:

- *SEACOM*

This is a first broadband submarine cable system in Africa which provides internet connectivity across Africa and across the world. Mozambique was connected to SEACOM in 2009 (Mabila, Mboane and Mondlane, 2010: 16).

- *E-governance, e-business and e-health*

Incorporating ICT infrastructure in governance, business and health, in order to improve the efficiency delivery of services provided by the government (OECD, 2008: 12).

- *Schoolnet Mozambique*

This project was launched in 1997 with the objective to introduce computer literacy in secondary schools and by 2006 there were more than 25 schools connected to the World Wide Web (Isaacs, 2007: 7).

- *Management of Natural Resources and Wireless Communication*

Using wireless radio phones in the field which connected to the base station. This provides immediate response for assistance (Conway and Rowan, 2003: 1).

- *Information, Education & Networking for Women via Internet*

This project involves the establishment of a website for woman that aims to improve access to information on gender related issues ((Isaacs, 2007: 10).

These projects are important as they not only assist towards the improvement of the general skills level in the country, especially the necessary technical skills required in a knowledge-based economy, but they also send a signal to foreign investors that Mozambique is serious about technological development.

5.2.2.3 Mozambique ICT Institute

The idea of a science park in Mozambique started with the approval of the ICT policy in 2000 and the launch of its Implementation Strategy in 2001 (MICTI, 2002). The Mozambique ICT Institute (MICTI) initiated by the University Eduardo Mondlane (UEM) was given the key responsilbity to implement the country's ICT policy. "This programme will draw on national and international business and academic partnerships to develop high-level ICT knowledge and skills to address the goals of development and strengthen the Mozambican ICT business sector" (ICT Policy, 2002: 5).

The vision of the MICTI is:

> *"To promote economic development in Mozambique through encouraging research and learning as well as the entrepreneurial spirit in ICT related areas, creating wealth for the tenants and for the country as a whole."*

The mission of the MICTI is:

> *"To create a dynamic environment from which participants are able to engage with academic and research endeavors, while simultaneously contributing to their own and the country's economic development, giving to the tenants' space, training and facilities in privileged conditions."*

The MICTI comprise of three key elements: research and learning, incubation for small business and the science park-project (ICT Policy, 2002).

(a) Research and learning

This first component addresses the lack of skills in the country by providing quality structured learning and relevant work-based experience in areas related to ICT, management and systems processing. This step is particularly relevant as has been explained in Section 2.2.2 that knowledge and skills development play a crucial role in a knowledge-based economy. Access to global expertise will be obtained by means of various exchange programs with international higher educational institutions, which conforms to the concept of

networking. Community education and training programs will also be offered (MICTI, 2002: 12).

(b)Incubator

The goal of this component is to provide opportunities for employment and wealth generating for students and the academic community of Mozambique (MICTI, 2002: 12). The development of incubator which was established in 2002 at the University of Eduardo Mondlane was also a crucial step towards the establishing formal and operational links with private and public HEIs in Mozambique and their scientific, research and technological expertise (Temlett, 2005: 21).

The MICTI Incubator is a pilot project for the establishment of the first science park Temlett (2005: 7) also refers to the presence of triple helix in the incubator, which refers to collaboration between academic institutions, government and firms. In Section 2.2.4 it was mentioned as one of the important elements for non-linear innovation models.

It was suggested that the MICTI incubator should be transferred to the premises of the science park upon its completion. However, Temlett (2005: 23) has some reservations. He argues that moving an incubator to the science park would be contradicting one of the key characteristics of proximity to HEIs institutions (refer to Section 2.4.1 on geographic proximity). On the other hand, the Minister of Science and Technology stated that Universities and HEIs will be established on the premises of the science park at a later stage. Temlet (2005:23) also argues that the establishment of a science park will imply that resources will be redirected from the incubator to the science park. However, one can argue against this point by saying that once the incubator is situated in the park, the resources will be distributed more efficiently across the entire project (Personal Interview, 2010).

(c) *Science and Technology Park*

The ultimate goal of the institute is to establish the science park. The mission of the Science and Technology Park in Mozambique is:

> "…to provide through the phased development of Mozambique's first prestigious Science and Technology Park in Moamba, a unique, sustainable and supportive environment for the development of entrepreneurial and educational activities that will facilitate business incubation, technology transfer, training and the commercial exploitation of the knowledge-base" (MICTI, 2002).

5.2.2.4 Finance

However, it is no secret that the Government of Mozambique cannot afford to finance some of the ICT-projects and therefore has to rely on donors. Various foreign donors are involved in the promotion of ICT-development. In the case of Mozambique, some donors are from the Scandinavian countries, others are the United States Agency for International Development (USAID), the United Nations Development Program (UNDP) and the World Bank (Paju, 2009: 53). However, reliance on donors is often not a first best option as they can cut funding at any moment, due to pressure from external or internal factors. For this reason some projects in Mozambique were not successful. Given the envisaged size of the park the potential exists to draw large domestic and international investment resources.

Fiscal benefits are "…those measurements that grant exemption or reduce the amount of tax payable by investors in order to benefit activities that have a recognised public interest as well as to encourage the economic development of Mozambique" (Legislation on the Investment in Mozambique, 2010: 56).

Law No. 4/2009 of January 2009 formulates the Code of Fiscal Benefits in Mozambique. Section IV of this Code applies specifically to investment into ICT-related initiatives:

> "…investment in scientific investigation, development of information and communication technologies, as well as research and development benefits for the duration of the project, from an exemption from payment of customs duties and VAT on the import of scientific, teaching and laboratory material and equipment, including software and support materials, for technical, scientific education, teaching and investigation construction materials, machinery, equipment, and the respective accompanying accessories and spare parts" (Legislation on the Investment in Mozambique, 2010: 68).

According to Section IV of the Code all investments made in the areas of science and technology in the science park will benefit as follows in respect of corporate income tax (IRPC):

- "Corporate Income Tax exemption in the first 5 years;
- A 50% reduction in the rate of IRPC tax from the 6^{th} to the 10^{th} tax year;
- A 25% reduction in the rate of IRPC from the 11^{th} to the 15^{th} tax year".

Apart from these allowances in the case of corporate income tax, other fiscal incentives are also offered to investors in the science park. For example, Article 6 offers an exemption from customs duties and VAT on imported or locally manufactured inputs. This exemption is granted for 5 years from the commencement of the project. Also, according to Article 19 of the code, during the first 5 years of the operation of a project investments made outside of Maputo City can benefit from 120% of the expenditure on the construction and rehabilitation in the following sectors: roads, railways, water supply, airports, telecommunications, electrical energy, mail delivery, hospitals, schools and other public sector services.

These generous tax exemptions to attract investments into ICT-related projects clearly show how serious the government is to enhance a knowledge-based economy in Mozambique, because the opportunity cost in terms of loss of government revenue should not be underestimated.

5.2.3 MICTI Science and Technology Park

The establishment of a science park is another ICT-related initiative by the Government of Mozambique. The science park is intended to stimulate technological development in the country by providing goods and services such as ICT hardware, software, biotechnology and call centres. In other words, the science park should assist the government to achieve its objectives of developing a knowledge-based economy.

The science park project in Mozambique is a public sector driven initiative, but is being established through a public-private partnership. As in many developing countries its financial viability relies on synergistic partnerships with the private sector, HIEs and global funding agencies. At the heart of this park will be the development of knowledge-based ICT projects. The development of other sectors such as medicine, mining and agriculture is also an objective of the park. The science park in Mozambique will have the generally established characteristics of clustering, academic-industry links and knowledge flows as discussed in Section 3.2.

5.2.3.1 Core Objectives

MICTI (2002: 56) identified the following core objectives for the science park.

- Be a catalyst for wealth creation and employment;
- Be a futuristic, prestigious and high-profile development which will attract and nurture new businesses and direct investment;
- Be the place from which knowledge-based companies (national and international) will wish to conduct their business;
- Be a vehicle for harnessing, stimulating and exploiting new thinking;
- Be a driver of best practice and a powerhouse of ideas;
- Be a multi-user centre of excellence, providing flexible accommodation and shared support facilities and services;
- Reinforce Mozambique's regional and international image and credibility.

These core objectives contain many of the essential elements of a knowledge-based economy as discussed in Chapter 2.

5.2.3.2 General characteristic of the science park

The science and technology park will comprise of research, learning and incubator components. Its implementation will be based on a 'special economic zone' (SEZ). The incentives explained earlier, will apply to investments in this special zone. These type of special zones were found to be particularly important in East Asian countries as explained in Section 3.6.3, with reference to empirical evidence from China. This is one of the very important steps that the Government of Mozambique has taken, firstly to create an enabling environment for the development of private ICT industries, and secondly to contribute to the creation of an educated and knowledge-oriented society (MICTI, 2002).

The development of small high-tech firms is at the heart of this project as explained in Section 5.1.1. The science park is believed to provide infrastructural support as well as technical and administrative support for small and medium high-tech firms. This is extremely important for economic development of the country given its very slow progress of SME development as mentioned in Section 5.2.1. It is believed that support to small and medium firms will enhance innovation and job creation.

The empowerment of local ICT industries and their attraction of foreign investment to the area will develop the Mozambican ICT industry and enhance related ICT-skilled human resource development. These businesses will benefit from as well as contribute to the science park and its related incubator and research and learning projects. Commitment to such an enabling environment is articulated clearly in the ICT Policy as approved by the Government in December 2000. This is seen as part of the government's commitment to create the necessary conditions for private business to thrive and also to address education and other human development needs (Personal interview, 2010).

The MICTI Science and Technology Park will consist of (MICTI, 2002: 59):

- *A greenfield site* development opportunity providing tenants the option of self-building or acquiring pre-built premises under flexible and competitive leasing and/or renting conditions;
- *A clustered zoning development* ensuring the grouping together of similar sector enterprises (clustering also referred to as geographic concentration in section 3.4.1 is one of the crucial characteristics of science parks).
- *A residential development* potential providing high quality leisure and life-style opportunities;
- *Manhica (location of the park)* which is regarded as a socio-economic 'hub' of future development with the potential to achieve 'city' status;
- *Environmental sustainability* through the usage of eco-friendly systems; efficient usage of energy (including solar), water resources, reduction of pollution and recycling of waste elements.

5.2.3.3 Location

As stated in Section 3.2 the location of a science park is particularly important to exploit the positive external impact of geographic concentration. It was explained that a science park should be located where other social and economic developments have already taken place. In accordance with this the Manhica district, situated in the neighborhood of the Maputo Corridor which links South Africa and Mozambique, was selected as the location for the first park. As part of the Maputo Development Corridor, which is the transportation link that connects Mozambique with South Africa, it enjoys easy access to the Oliver Tambo International Airport in Johannesburg and to other road and rail transport routes, including Maputo Harbour which is essential for import and export services. Additionally, a railway station exists in Manhica village and the Rail Authorities of Mozambique have confirmed

that if sufficient demand for rail services is generated, a branch-line will be built to link the village station directly to the science park (MICTI, 2002: 11).

5.2.3.4 Science park phases

Parque Expo is a public enterprise in Portugal which accepted responsibility for the strategic and urban planning of the park in Manhica. As suggested in the master plan created by Parque Expo (2009), this first science park, located in the Maputo Province, will be developed in two phases (Parque Expo, 2009):

(a) Phase 1

The first phase of the park is further subdivided into three distinct stages:

- Stage 1: Urban planning of 360 hectares of land provided by the Government of Mozambique.
- Stage 2: The establishment of access routes and fencing of the premises.
- Stage 3: The establishment of prestigious multipurpose Technology and Innovation Centre (TIC) and basic infrastructure development: water, electricity, roads and communication.

This centre is envisaged to be an important vehicle in moving the emerging research capabilities from the HEIs into applied and commercial applications to ensure the effective flow of knowledge. It is further envisaged that by creating the right environment, intellectual property (refer to in Section 2.2.2.1) will be created which can be exploited for commercial gain (Personal interview, 2010). Synergy between the institutions of Higher Education and industry is a two-way process and it is intended that the Technology and Innovation Centre will become the service provider for facilities for industrial research, consultation and training services and training (Personal interview, 2010). It was planned that this centre will employ a multi-disciplinary team of academics, researchers and technicians.

MITCI (2002) identified the following advantages of such a centre:

- Development of university/industry alliances including the establishment of an Industrial Research Team supporting local industry;
- Enrichment of the academic curriculum through the feeding back of experiences gained in an industrial working environment;
- Academic staff gaining greater incentives and motivation through industrial experience;

- Greater potential for engagement of undergraduates and postgraduates in industrial projects;
- Opportunities for income generation through consultancy, joint research programs, access to equipment and facilities and exploitation of IPR.

Should the centre be able to live up to these expectations, it will go a long way towards the establishment of a knowledge based economy.

It was estimated that the construction of the first phase will cost approximately USD25 million. This was financed by means of a line of credit (LOC) provided by the Indian government through an Export-Import Bank of India (Department of Science and Technology, 2009). Brigham and Davis (2003 728) defines a line of credit as an arrangement between a financial institution, usually a bank, and a customer that establishes a maximum loan balance that the bank will permit the borrower to maintain. The borrower can draw on this line of credit at any time, as long as he or she does not exceed the maximum set in the agreement. The benefit of such a LOC rather than a normal loan is that the interest is only charged on the amount used and the debt on the LOC can be re-negotiated on an annual basis because the debt matures annually. It is understandable that the Government of Mozambique opted for this type of loan.

Jaguar Overseas[44] is the construction company that signed a contract in March 2010 with the Ministry of Science and Technology and promised to complete the first phase with its first TIC building in approximately 12 months (Mitra and Bhuvaa, 2011). According to the Minister of Science and Technology the first phase is still under construction (Personal interview, 2011).

(b) Phase 2

This phase of the park will include its expansion to 950 hectares of the land. Given that the TIC will only occupy 3 hectares, the remaining 947 hectares are set aside for the establishment of universities, training centres, schools, accommodation, sport facilities and shopping malls. Consequently, the science and technology park will surround the Centre. The objective of TIC is to create an environment of cooperation between commerce, education and research, by stimulating creativity, innovation and entrepreneurship. This conforms to the

[44] An Indian Company, part of the O.P. Jindal Group.

notion of triple helix, referred to in Section 2.3.2.2(d), which relates to collaboration between academia, government and private sector firms.

It is still not clear how this phase will be financed. However, given that the Government of Mozambique has decided that this park will be established through a PPP-project, it is probably assumed that once the first phase of the park has been completed and the park starts to operate, it will generate enough funds and attract enough investments to complete the rest of the project. It is however doubtful whether the lower levels of government will be able to make a significant contribution as in the case of North America (See Section 3.5.2). The government will have to rely to a much larger extent on international institutions, such as the World Bank. However, given the strong role of the ISPA as well as the SIP in countries, such as India and China, it would be advisable to get the support of these institutions.

5.2.2.5 Target client groups and tenant selection criteria

MICTIs Technology and Innovation Centre will let units to domestic organisations and entrepreneurs. It will focus on, but not be restricted to, ICT projects. Similarly, the science and technology park will offer accommodation for local and international organisations. The intention is to maximise the possible advantages for the economy of Mozambique and its development potential by attracting investment in selected sectors of the country (Personal interview, 2010).

The objective is to attract a sufficient number of key players in the market to create an optimal mix of tenants to obtain a synergistic cohesion. This should enhance the development of the science and technology park as a key centre of enterprise and innovation, with spin-offs in terms of linkages between established and emerging enterprises (Personal interview, 2010). The target group of tenants consists of (MISTI, 2002: 59):

- "High Technology and Knowledge-based organisations;
- ICT and other industrial sectors (biotechnology, chemicals, food, engineering, etc.);
- International research and development operations;
- Academic and graduate operations"

A flexible selection criterion will be applied depending on the destination and resource level of the prospective tenant. For example, the selection criteria for prospective international corporate entities and domestic organisations may be different. There must be a match between the tenants' activities, and the objectives and goals of the science park. Furthermore, specific principles will underpin the flexibility of tenant selection criteria. For example: if

almost all tenants in the park are involved in electronic engineering, a firm that does research in the development of a new potato variety will be a mismatch, because this firm will have nothing to contribute to the general theme of the park.

A primary objective of this park is the establishment and maintenance of ongoing links and relationships with Higher Education and Research Institutions in Mozambique. This will contribute to human capital development as students will have the opportunity to engage in research and innovation. As stated in Section 3.2, academic-industry links are imperative because a firm that is developing a product is in this park with have the opportunity to liaise with the academics on a continuous basis. This should ensure a successful product development attempt and should also ensure that a product or service for which there is a demand in Mozambique, is developed.

5.2.2.6 Governance and Management Structure

Due to the nature of the MICTI science and technology park development, the primary stakeholder is the Government of Mozambique. It is envisaged that a substantial portion of the initial funding requirements will be sourced from donors (World Bank), lenders (example of India) and development agencies (USAID) (Personal interview, 2010).

Following extensive consultation between project leaders and advisory teams, a system of governance, incorporating financial transparency and management accountability, was formalised. It stipulated that stakeholders and management should agree to the following (MICTI, 2002: 60):

- Science park management will be transparent and accountable;
- Tenant selection and management will be conducted in an ethical and non-discriminatory manner;
- Processes and procedures will be optimised resulting in a minimum of bureaucracy;
- Management of the science and technology park will operate under the guiding principles of maximising assistance and minimising interference to its valued tenants.

From these points one can derive that the Government of Mozambique is striving to provide the necessary institutional arrangements and policy support to ensure an efficient and productive science park.

5.2.2.7 Strategic Partnerships

As stated in Section 4.5.2, finding good partners for the establishment of a science park is important. The MICTI science and technology park planning program has gained much from working together and also sharing the experience of the following world-class organisations (MICTI, 2002: 17):

- *UKSPA*
  This is an association that assists established science parks based on innovation, knowledge and know-how distribution across the world.
- *Manchester Science Park*
  It is a science park in the UK which supports high-tech firms in a number of sectors such as ICT, biotechnology, industrial technologies and digital media.
- *University of Warwick Science Park*
  This is a university-based park in the UK which includes a business innovation centre, innovation centre, university and a science park.
- *Europarc Innovation Centre*
  This UK innovation centre assists newly established firms to gain access to the UK and European markets.
- *Newlands Science Park*
  This science park, established in the 1980s, is located on the premises of the University of Hull in the UK.
- *Campus Venture Incubator Centre*
  This Incubator is located at Hongik University in Korea and its key objective is to promote the establishment of small high-tech firms.
- *Blythe Valley Innovation Centre*
  This centre is located on the premises of Birmingham Science and its key objective is to provide an environment of knowledge-based businesses.

It is clear that all these institutions play a very important role in the diffusion of knowledge en technological know-how. To join forces with such organisations can only benefit the development of a knowledge-based economy in Mozambique. It can be expected that such cooperation will result in positive external spin-offs.

The British Council in Mozambique contributed a significant amount towards the operational costs incurred in the UK Study Visit Program in Mozambique (Mozambique New Agency, 2010). Strategic partnerships were also developed (and will be developed in future) with HEIs, NGOs, research organisations, commercial associations, financial institutions, as well as key domestic and foreign private sector firms, such as Mozal, Vodacom and Sasol. In other words, the government of Mozambique intends to create strong networks of cooperation with HEIs, academia and the industry. The general characteristic of university-industry links are taken very seriously.

India is also one of the biggest supporters of the establishment of science parks in Mozambique. India not only provided financial support for the establishment of the first science park in Mozambique, but also offers their experience and intellectual know-how by sending some of the best experts to the country. India is likely to play an important role as strategic partner.

In summary, it appears that all the necessary steps have been taken for the successful establishment of the science park. The tenant selection includes not only start-up firms, but also multinationals and mature companies. Strong relationships have also been established between the academia and the science park, which should provide the necessary technical skills. With regards to the physical characteristics, the park embodies all necessary components to promote sustainable business development. Despite the fact that human resources in technical areas are still lacking in the country, the government has put in place the necessary institutional support to promote skill and knowledge development (research and development component). Lastly, the intended collaboration between the public and the private sector is at the heart of this science park.

5.3 ESTABLISHING THE SCIENCE PARK WITH PPP-PROJECT

5.3.1 Background overview

The financing of a science park project, as explained in Section 3.5, is an immense challenge. Using a PPP for its establishment is even harder, given that there are not many parks that have been established in this manner and there is little empirical evidence to prove that it can actually work. One example where a PPP was used to create a science parks was found in Brazil.

This idea to use a PPP for the establishment of science parks was presented at the 27th World Conference on Science (Gargione et al, 2010). It was argued that a PPP is the most suitable type of model to establish a science park in developing countries, based on the fact that most governments in these countries lack the financial means to establish a project of this massive nature. Without the involvment of the private sector and especially private international investors, it is impossible to embark on a project of such a nature. As illustrated in Section 4.4.2 the collaboration between the public and the private sector can be beneficial for both.

The issue of PPPs in Mozambique was the subject of a conference called "Public-Private Partnerships in Mozambique", held in Maputo on 1 October 2002, under the support of the OECD Development Centre. It was widely represented by members of the public and private sectors in Mozambique (Tribunal Administrativo, 2006). The main objective of this conference was to create awareness about PPPs and to facilitate the creation of a PPP to support the government, the private sector and all other economic partners (Tribunal Administrativo, 2006).

The resent strategies of the Government of Mozambique confirm the government's commitment to create strong linkages between the public and private sector in respect of public service delivery. Some major projects are being implemented, based on this envisaged cooperation between the public and the private sectors. One such project is Mozambique eGovernment and Communications Infrastructure Project (MEGCIP)[45] (World Bank, 2009). These projects will surely enhance ICT development in the country. In the case of Mozambique where the goverment is highly indebted and unable to finance these types of mega-projects this seams seems to be a first best choice. The Government of Mozambique realised that in order to ensure the sustainable development of this park as well as future parks (given that three additional parks are planned for the near future across the country), strong institutional support should be provided together with the necessary regulatory framework and necessary fiscal incentives.

5.3.2 Example of Brazil

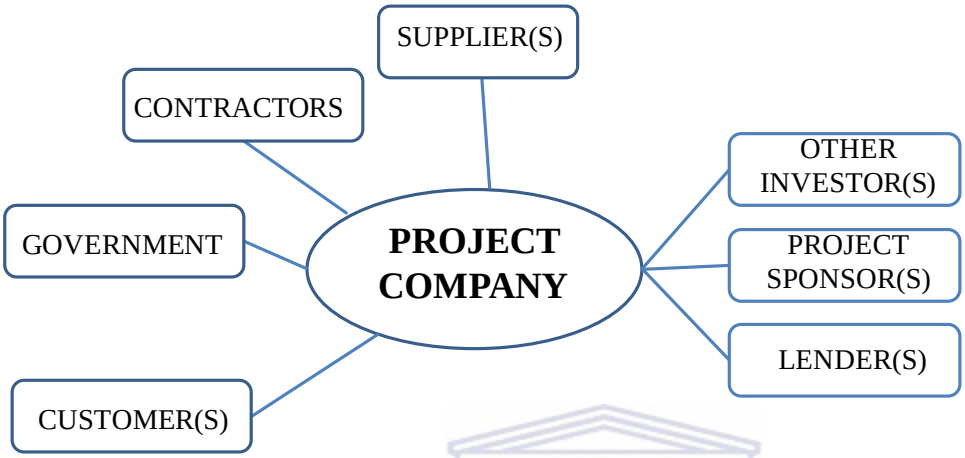
It is important to consider the specific PPP model used for science parks in Brazil because Mozambique can use it as a reference and to derive lessons by investigating their experiences, successes and failures. Just as in the case of Mozambique, the government of Brazil played an important part in the provision of public goods and services. Because of the inefficienc of state-owned enterprises the Brazilian government also embarked on a privatisation programme as structural reform in the early 1980's. However, after the failure of the privatisation programme, the country was hit by a serious financial crises. Along with

[45] For more information on MEGCIP refer to World Bank's article "Mozambique technical annex on a proposed credit". Report No. T7719-MZ

many other countries, the government realised that full privatisation failed to address socio-economic issues, also due to a lack of the necessary regulatory framework (Farlam, 2005:3).

The government of Brazil promulgated their Law of public-Private Partnership in 2004.

Figure 4.3 Science park model



Source: Gargione et al (2010: 10)

Figure 4.3 shows that at least seven partners, namely the government, suppliers, contractor, customer, investors, sponsors and lender contribute to the financing of a project. Major proportions of the finance come from the group of private investors, sponsors and lenders. The government of Brazil would mostly play the role of regulator and the rest of the players would support the project by providing goods and service (suppliers), maintaining the project (contractors) and buying the products and services (customers). Policy makers in Mozambique should study the Brazilian example carefully as there may be important lessons to be learnt and Mozambique are still in the early stages of the establishment of the science park though the establishment of a PPP.

5.3.3 Examples of PPP-projects in Mozambique

As stated by the Administrative Council of Mozambique (Tribunal Administrativo, 2006) there are a number of projects in the country which are considered to be PPPs, since they have characteristics similar to this type of partnership. These are long-term projects with secure contractual obligations of various types (as explained in Section 4.3.1). In some cases a private partner takes care of projections, construction operations and maintenance of the

enterprise[46]. In order to investigate the viability of the establishment of the science park by means of a PPP, it is important to consider other PPP-projects in Mozambique. The following are examples of PPP-projects:

5.3.3.1 The N4 Toll Road

The N4 Toll Road that connects Mozambique with South Africa was established through a PPP. The two countries signed a 30 year concession in 1996 for a private consortium to build, operate and transfer (BOT) the N4 Road (eAfrica, 2005). After 30 years the control and management is intended to pass on to the respective governments. With regards to financing, 20% of the project was financed by equity and 80% by debt. Three construction companies (Stocks and Stocks, Bouygues and Basil Read) were the main sponsors of the project and contributed R331 million. The balance was funded by SA Infrastructure Fund which is an unlisted infrastructure fund that targets equity investments in sub-Saharan Africa.[47]

Farlam (2005: 11) claims that this PPP project can be regarded as successful because of the significant reduction in the overloading of heavy vehicles, which caused considerable deterioration of the roads. The maintenance of the road is more efficient and cost-effective given that there was a significant reduction in the overloading of heavy vehicles which caused considerable deterioration to the roads (Taylor, 2000: 4). Moreover, good roads positively impact on the tourism sector in Mozambique and on other sectors of industry, such as the Mozal aluminium smelter and the natural gas plants at Pande and Temane.

A key determinant, according to Section 4.5.6, that is present with this N4 PPP initiative, is the sound regulatory framework. Moreover, transparency was secured through continuous dialogue with the surrounding communities with regards to how they will be affected and how they can benefit from the PPP-project (Taylor, 2000: 17).

5.3.3.2 The Heritage Water supply project.

Another example of a PPP is the management of water supply in the country. A contract was entered into between the investment fund and the Heritage Water Supply (FIPAG) as grantor

[47] It is managed by Old Mutual, Standard Bank, Futuregrowth, Liberty Life Insurance Company, The Transnet Pension Fund and Public Investment Commissioners. It focuses on private sector investment in infrastructure projects in Southern Africa.
[45] Section 3.3 distinguishes between different types depending on the allocation of responsibilities.

and the Waters of Mozambique, SARL, as an operator. The contract encompasses the following: “FIPAG awarded a USD 25million contract in two parts to AdeM; a 15 year lease to operate water and distribution for Maputo and a 5 year management contract to operate water and distribution in four other cities” (Qizilbash, 2011: 46). This contract can be considered a PPP, of the type: design, rehabilitate, operate and transfer (DROT), because it fits the type of management, where the private sector manages the equipment and installation, but was not responsible for the cost of construction and installation.

According to the Tribunal Administrativo (2006) the operator had "the skills and qualifications to enable him to manage, operate and maintain the facilities effectively with optimum costs, increasing revenues and progressive development of a financially sustainable system of water supply ..." With regards to regulatory and institutional framework (Refer to Section 4.5.6) three institutions were established to secure different levels of service delivery to poor communities, namely Standpipe Management Working Group, the permanent Water and Sanitation Working Group and local Community Water Committees (UNDP, 2010). Furthermore, the government of Mozambique regards the issue of accountability as very important and appointed FIPAG, which is independent asset management firm, to ensure independent and efficient functioning of this PPP-project (Qizilbash, 2011: 51).

5.3.3.3. Vilmar Roses

An example of a mega-project in Mozambique that failed recently is that of Vilmar Roses (Hanlon, 2006). This project began in 2001 and it was supported by the government of Mozambique in partnership with Flocdac (Dutch Company) and Vilamr (Zimbabwean company). The objective of the project was to export roses from Manhica (Mozambique) to the Netherlands. In 2001 a Dutch government agency, PSOM provided financing to the amount of USD725.000. In 2003 additional financing of €1 million was obtained through Norsad, the Nordic-SADCC development fund. However, by 2006 the project was terminated and the managers of the two companies deserted the project and all its employees.

There are various speculations regarding why this project failed. Firstly, the feasibility studies done on this project had contrasting outcomes. (Section 4.5.1 refers to the importance of a feasibility study as determinant of the success of PPP-projects.) One study promised that this project will be a “success story” in Mozambique, while the other argued that it will fail due to unfavourable conditions for growth of roses in the country (Hanlon, 2006). Consequently,

inadequate project evaluation may be one of the reasons why this project failed. Secondly, choosing appropriate partnership is another determinant that was overlooked by the government in order to ensure the success of this project. Both PSOM and Norsad were very secretive about their strategies and decision making. Therefore there was a lack of transparency and accountability, also two factors that were referred to in Section 4.5.8 (Hanlon, 2006). Some researchers argue that the project failed due to lack of communication and openness between the partnering countries, others blame it on corruption (Hanlon, 2006). Bureaucratic behaviour also prevented efficient functioning of the project (Saunders and Saunders, 2006).

Given the examples of PPP projects in Mozambique and the fact that the government recognises the role that the private sector can play in the provision of infrastructure and other public sector services, the Council of Ministers agreed in October of 2010 that it was necessary to establish the Law of PPPs. At the time of the personal interview (2010) the detail was still confidential. This law has not been promulgated, however, it is a step in the right direction to formalise institutional arrangements related to the establishment of the PPP. Policy makers and bureaucrats should however pay attention to the various factors that determine the success of failure of PPP-projects. It is interesting how the examples form Mozambique confirmed the importance of the various determinants explained in Chapter 4.

5.4 SUMMARY AND CONCLUSION

The economy of Mozambique have shown some remarkable improvements over the last decade and various policy approaches give a clear indication that the Government of Mozambique is serious in its efforts to develop a knowledge-based economy.

Apart from the development of various mega projects, major progress was also made in the ICT sector. The government regards the further development of ICT as critical for the establishment of knowledge and efficient communication networks. Various ICT4D initiatives, such as SEACOM and Schoolnet Mozambique were implemented and will surely making a difference to the skills level in the country.

The country approved an ICT policy in 2000 and launched its implementation strategy in 2001 in Mozambique. The Mozambique ICT Institute has a crucial role to play in this

implementation strategy which has three elements: research and learning, the incubator and the science and technology park. The MICTI incubator was a pilot project for the launch of the science park.

The mission of the Science and Technology Park in Manhica is to provide a unique, sustainable and supportive environment that will facilitate business incubation, technology transfer, training and the commercial exploitation of the knowledge-base. It was decided that the science park will be established through a PPP-type of project, despite the fact that there is not much evidence on science parks that were established in this manner. PPP-projects are normally used for the provision of various types of infrastructure. It is important that the PPPs of Brazil should be thoroughly investigated.

CHAPTER SIX

GENERAL CONCLUSION

The study focuses on the importance of the development of knowledge-based economies and on the role and ICT and networks in its establishment. Chapter one presented the conventional problem statement, objectives and explained the structure of the study. It explained the increasing importance of knowledge-based economies and the role of ICT in such economies. The government of Mozambique openly proclaimed its decision to take the necessary steps to enhance the diffusion of knowledge and information via ICT development.

Chapter two presented the theoretical framework, explaining the meaning of knowledge and its role with reference to the neo-classical, new growth and human capital theories. It distinguished between specific and general knowledge and also between the types: know-what, know-why, know-how and know-who. General knowledge will have greater positive external impact as it can be more widely applied. ICT and knowledge networks play a crucial role in a knowledge-based economy. Linear and non-linear models of innovation explained the existence of knowledge networks. Linear models are science push models, whilst non-linear models accentuate important feedback loops, communication between economic agents, national innovation systems and triple helix, referring to consistent collaboration between academia, government and the private sector.

Chapter three firstly defined the concept of a science park and explained important features of clustering, academic-industry linkages and knowledge flows. Thereafter the focus was on the evolution from first generation science push models to third generation models which are more cluster driven and market oriented. It was explained that science parks can facilitate the diffusion of knowledge and information, promote technological change, have a positive external effects due to geographic concentration, can be a seedbed for entrepreneurship and innovation, thereby stimulating regional and urban development. It can be derived from the literature that the establishment of science parks has become an important policy instrument towards the development of knowledge-based economies. Some empirical evidence from Finland, India and China was presented. It is clear that the establishment of science parks in these countries enhanced the development of knowledge-based economies. Important lessons could be derived from their experiences. One element which is important for transformation into a knowledge-based economy is institutional support. It is also clear in all cases that the

governments of these countries have made substantial allowances in terms of tax concessions to attract investors.

Chapter four focused on the role of PPP projects in developing countries. PPPs are frequently used in transport, water, health and telecommunication sectors. The different types of PPPs, relating to the different roles of the public versus that of the private sector, were explained as well as the main characteristics. Four main motivations for the use of PPP-projects were identified, namely an increase in economic efficiency, cost-superiorly, political benefits, risk sharing and reduced risk. From the literature some key determinants for a successful PPP-project were derived. These are strong institutional support and an effective regulatory framework, clearly defined roles and responsibilities (including financial) of public and private parties and mechanisms should be imposed to secure accountability and transparency.

Chapter five presents a case study on Mozambique. Here it was illustrated that the Government of Mozambique embarked on the number of policies with the objective of transforming the economy to become knowledge-based. The objective of these policies is to address the developmental challenges of the country through research and development (R&D) and learning, by using ICTs in all areas of the economy. One of the key components of this strategy is the establishment of a number of science parks across the country. The first science park is strategically positioned in Maputo province near the capital and major transport routes. It is a government initiative but the government decided on a PPP-project to establish the first science park. This decision seems logical given that the government relies on aid and debt to balance the national budget.

It seems as if the Government of Mozambique is providing the necessary institutional support for the successful and sustainable establishment of the park. This support can be seen through the development of infrastructure, establishment of appropriate fiscal incentives as well as the proposal for the implementation of PPP Law. But there are also challenges. These include inadequate financial resources for the establishment of the park, lack of know-how, knowledge and training in high-tech skills and lack of innovation. It can also be recommended that the government should ensure transparency and accountability.

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