"The effect and influence of gatekeepers on technology transfer in Institutes of Technology in Ireland"

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Abstract

The purpose of this study is to examine whether gatekeepers influence technology transfer within the Higher Education Institute (HEI) sector. It is important to note that the higher education sector in Ireland is known as a binary system of education in that it consists of both universities and Institutes of Technology (IoTs). Both sectors are treated differently in funding allocation and research and innovation. This study chose to research the IoT sector as the majority of literature surrounding technology transfer is written and commented on from a university perspective.

A phenomenologist philosophy was employed using qualitative methods. Rice and Matthews (1993) and Duff (1994) stated that incubation centres, within an industry context, were the hub of technology transfer with incubator managers being gatekeepers of the technology transfer process. Therefore, it is not unreasonable to expect that campus incubation centres and their managers located in the 14 IoTs in Ireland would also be hubs of technology transfer. A sample was obtained of the 15 IoT campus incubation centres using a number of selection criteria. Data were collected for this study through semi-structured interviews with six incubation centre managers. The managers revealed that they did not consider themselves to be gatekeepers of technology transfer but instead identified 23 individuals who they believed were gatekeepers of technology transfer in the IoTs. The semi-structured interviews enabled the researcher to establish information regarding the gatekeepers' education qualifications, industry experience, network contacts and whether the skills gained had an influence on technology transfer within the IoTs. Based on the interviews with the gatekeepers the researcher decided to interview ten key government officials in various government funding agencies in Ireland as it became apparent that there were some issues regarding the Irish government's methods of allocating funding to HEIs.

A number of important findings emerged from this study. The research identified that individuals identified as gatekeepers in IoTs possessed all the capacities of organisational gatekeepers described by Allen (1977). Furthermore, the research findings confirmed that technology transfer is not just a step-by-step process running from invention disclosures to wealth. In fact, this research has found that the technology transfer process starts with gatekeepers gathering and disseminating knowledge and sharing this knowledge with the academic community. They in turn motivate and inspire academic faculty to file invention disclosures and engage in the technology transfer process. It was also discovered that gatekeepers believed that without their presence in the IoT, technology transfer would not occur. The gatekeepers also believed that the skills gained as a result of their previous experience influenced the technology transfer process. However, from the research findings it emerged that skills gained during their education actually provided gatekeepers with more knowledge transfer capacities than they acknowledged.

As mentioned previously Ireland possesses a binary education system consisting of seven universities and 14 IoTs. The university sector is traditionally more successful at obtaining research funding then IoTs. As a result of this, the research found that the allocation of funding by government funding agencies has caused dissatisfaction amongst the IoT sector in particular, towards the metrics used by Enterprise Ireland (EI) to measure technology transfer in HEIs. The gatekeepers believed the funding they received from EI was not adequate and that they were treated differently to universities regarding the level of support received for technology transfer. This research will add to the expanding body of literature on technology transfer as it was established that technology transfer required knowledge to be transferred in order to be effective and that knowledge transfer required the existence of individuals to disseminate knowledge in order to be effective. Finally, this study examined of the impact of policies enforced by government funding employees on gatekeepers' ability to encourage technology transfer in IoTs. Therefore, this study has implications for researchers, policy makers, higher education authorities, government funding agencies in Ireland and individuals engaged in technology transfer.

Declaration

I hereby declare that the material is entirely my own work and has not been submitted as an exercise or degree at this or any other higher education establishment. The author alone has undertaken the work except where due acknowledgement has been made in the text.

Niamh Owens

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Table of Contents

Chapter 4- Philosophical Considerations and Primary Research Approach

Chapter 5- Gatekeepers' influence on the technology transfer process

List of Figures

List of Tables

Abbreviations

ARE- Advanced Research Enhancement Centre
AUTM- American University of Technology Managers
ESG – Enterprise Strategy Group
EI- Enterprise Ireland
EU- European Union
FDI – Foreign Direct Investment
HEA- Higher Education Authority
HEI- Higher Education Institute
ICT – Information Communication Technology
ILM- Industrial Liaison Manager
IoT- Institute of Technology
IoTi – Institutes of Technology Ireland
IUA – Irish Universities Association
MNE – Multinational Enterprise
OECD- Organisation for Economic Co-operation and Development
R&D- Research and Development
ROI- Return on Investment
RTC- Regional Technical College
SFI- Science Foundation Ireland
SME- Small and Medium Enterprise
SSTI- Strategy for Science, Technology and Innovation
TSI- Technology Strengthening Initiative
TT- Technology Transfer
TTO- Technology Transfer Office/Officer
UK- United Kingdom
US- United States

Chapter 1: Introduction

Chapter One **Introduction**

1.1 Introduction

This chapter provides the rationale for conducting this doctoral thesis on the impact of gatekeepers on technology transfer. In doing so the chapter addresses the background to the study, its location within the literature and the associated research question and objectives. The existing studies in the area are reviewed and the gaps within the literature are identified. From reviewing the literature on technology transfer it is described as a step-by-step process which starts with filing invention disclosures and eventually leading to the creation of jobs and wealth. However, to date there has been limited studies on the technology transfer process which encompass the influence of individuals.

The setting for this research is the technology transfer process that occurs in a particular form of higher education institute (HEI), the Institutes of Technology (IoTs) in Ireland. It is important to note that Ireland consists of a binary system of higher education which includes both universities and IoTs.[1] According to Hazelkorn and Moynihan (2010) universities and IoTs have been treated differently in policy, funding and recognition. Regarding the role of research in IoTs the University Act (1997) confirmed research as an unqualified function of universities stating that universities should promote and facilitate research. The Act stated that research be performed exclusively in universities while IoTs should focus on maintaining regional relationships and not engage in research activity. This has delayed the development of research in IoTs.

The OECD (2004), in their review of the Higher Education System in Ireland, stated that IoTs should not be involved in similar research activities that are undertaken by the university sector. In fact, the OECD stated that IoTs should remain in their original function as regional technical colleges that provided education in engineering and science. However, there are references in other documents such as the Strategy for Science Technology and Innovation (SSTI) (2006) and

[1] The Binary system of Higher Education in Ireland consists of seven universities, 14 IoTs, nine Colleges of Further Education, the National College of Art and Design and other national institutions (OECD, 2006).

Building Ireland’s Smart Economy (2008) that IoTs should focus on research. In reality, differences in core funding allocation between universities and IoTs have played a greater role in defining their missions and role in the higher education sector. This being the case, this study focuses its attention on the research that occurs in IoTs, particularly the technology transfer process. While the majority of literature on technology transfer processes in HEIs is written from a university perspective, this research investigates technology transfer that occurs in IoTs and the influence of gatekeepers on the process.

Garud and Nayyar (1994) stated that an organisation’s ability to disseminate and transfer knowledge will determine its level of participation in the technology transfer process. The authors stated that this would impact on the effectiveness of the process. Furthermore, Goh (2002) suggested that effective knowledge transfer relies on an organisation that possesses a culture that supports employees through collaboration, leadership, support structures, trust and absorptive capacity. Therefore, it could be concluded that individuals are required for a successful technology transfer process as it has been stated that individuals are required for knowledge to be disseminated within and outside an organisation. In industry specific research, such individual’s have been described as gatekeepers by Allen (1977). Gatekeepers are unique to an organisation as they gather, disseminate and decode knowledge needed by those involved in the technology transfer process. Therefore, if technology transfer increases as a result of an individual’s ability to gather and disseminate information then it is not unreasonable to expect that the technology transfer process that occurs in IoTs would also comprise of gatekeepers whose responsibility involves the dissemination of relevant knowledge to those involved in the technology transfer process. Therefore, the primary aim of this study is to investigate the existence and influence of gatekeepers on the technology transfer process in IoTs.

1.2 Research Rationale

The context for this study is the recognition by the Irish government that it can no longer rely as strongly as it did in the past on Foreign Direct Investment (FDI) alone to sustain the economy in the future. The Enterprise Strategy Group (ESG) (2004) report stated that there are still low levels of exports from indigenous SMEs with Ireland still relying on Multinational Enterprises (MNEs) for trade. MNEs, for example Bausch and Lomb and Boston Scientific, exports account for 80% of total exports out of Ireland. There exists the ever-increasing risk of losing these MNEs because of increased globalisation and if these high exporting MNEs leave, then there is a danger that Ireland's economic growth could experience a serious setback as Ireland relies heavily on MNEs for trade. The results of these setbacks have already been witnessed with large MNEs such as Dell relocating to lower cost economies to produce their products. The effect of these large enterprises is that they have masked the generally poor performance of the indigenous sector. This trend will continue if Ireland does not change its focus and look to the higher education sector for a return on the investment that the government has made (SSTI, 2006). Consequently, the Irish government has come to realise that it will need to start investing in and encouraging more research and innovation in Ireland and reduce their reliance on the exports generated from MNEs (Ahead of the Curve, 2004; Strategy for Science Technology and Innovation, 2006). Higher education was just one of the areas of research and innovation which the government has invested heavily in since the publication of the SSTI (2006) report. Hence, there are two underlying reasons why this research is important:

(1) Since 2006 approximately €3.46 billion has been invested by the Irish government to develop world class research in science, technology and innovation in the HEI sector. Since then, the government has been actively seeking a tangible return from this investment.

(2) As a result of this increased focus on investment in research and innovation, one of the main government funding agencies, Enterprise Ireland (EI), is focusing its resources on generating tangible results from the money it has invested in the Higher Education sector. In particular, EI has invested €237 million in funding in IoTs since 2006. The main method EI is utilising to achieve this return in investment is through the commercialisation of technology being produced.

The commercialisation of technology is one of the main outcomes of a successful technology transfer process (Cunningham and Harvey, 2004). However, before technology can be commercialised, knowledge needs to be transferred (Garud and Nayyar, 1994). From a HEI perspective, it has been remarked that academic faculty possess the responsibility of transferring this knowledge (Friedman and Silberman, 2003). This would, therefore, suggest that individuals have a significant role in the technology transfer process.

However, during the course of researching literature on the technology transfer process by researchers, such as Gibson and Slimor (1991) and Bozeman (2000), it became apparent that the influence of individuals on the technology transfer process has not been researched or documented extensively. Much of the literature on technology transfer describes the process as a step-by-step progression which eventually leads to the commercialisation of a technology and it is this description that has been implemented and referenced by many researchers (Cunningham and Harvey, 2004). While Garud and Nayyar (1994) stated that technology transfer required the dissemination of knowledge to be successful, Bozeman (2000) and Friedman and Silberman (2003) do not illustrate this fact in their model of technology transfer. Consequently, this provided the researcher with the motivation to look more closely at this situation and to question the existence and influence of individuals on the process.

It has been stated in literature that knowledge transfer is needed for technology transfer to be successful (Garud and Nayyar, 1994). Allen (1977) viewed gatekeepers as being involved in the dissemination of knowledge in an organisation therefore, it would not be unreasonable to expect that gatekeepers also exist in knowledge transfer processes in HEIs and impact on their technology transfer processes. A more in-depth understanding of these individuals will add to the growing body of literature on the technology transfer process. As this research is based on examining how gatekeepers influence technology transfer, it was informed by the following key areas of literature:

(1) Technology transfer and Knowledge transfer:

The theory on technology transfer and its process (Friedman and Silberman, 2003) is examined. Furthermore, the role of knowledge transfer in the technology transfer process is also investigated as Garud and Nayyar (1994) stated that technology transfer cannot exist without individuals to transfer knowledge in the organisation. Included in this section of the literature review is the theory on gatekeepers and their role in the technology transfer process from an industry perspective.

(2) Network theory:

Previous research has found that the activity of technology transfer increases as the network interactions amongst individuals in organisations increases (Oliver and Liebeskind, 1998). Therefore, this current research explores the areas of network theory and the effects of networking on the technology transfer process.

(3) Absorptive capacity of individuals:

Absorptive capacity has been defined by Cohen and Levinthal (1990) as an organisation's ability to assimilate, disseminate and exploit outside knowledge. Therefore, the examination of the absorptive capacity of individuals provides valuable information on their effect on the technology transfer process. This section also makes reference to research by Venkataramen (1997), Shane (2000) and Bercovitz and Feldman (2003) about how the education and experience of individuals can influence their ability to disseminate knowledge.

(4) Government policy:

This key area of literature examines the impact of government policy on the technology transfer process. This section of the literature review investigates the effectiveness of the relationship between government funding agencies and higher education institutes and the effects of governments seeking a return on their investment on the technology transfer process.

This research contributes to literature on technology transfer by investigating the influence of gatekeepers on the process which in turn will have implications for policy-makers, academics, technology transfer personnel, industry, government funding agency employees and higher education authorities.

1.3 Research Question and Objectives

The research question arises from the research problem. According to Chisnell (1997) it is important that the research problem is defined effectively. It is '*critical*' as it describes the '*nature and direction*' of the complete research process (p.35). Malhotra (1996) also stated that the research problem is '*the first step in any research process*' (p.38). This current research has already established from research by Allen (1977), Garud and Nayyar (1994) and Nikulainen (2007) that gatekeepers have the ability to transfer knowledge in an organisation and consequently, impact on the transfer of technology. However, this impact has been described mainly from an industry perspective. The existence of gatekeepers in HEIs, and more importantly IoTs, has not been researched in extensive detail. Figure 1.1 outlines this study's research questions, aim and objectives.

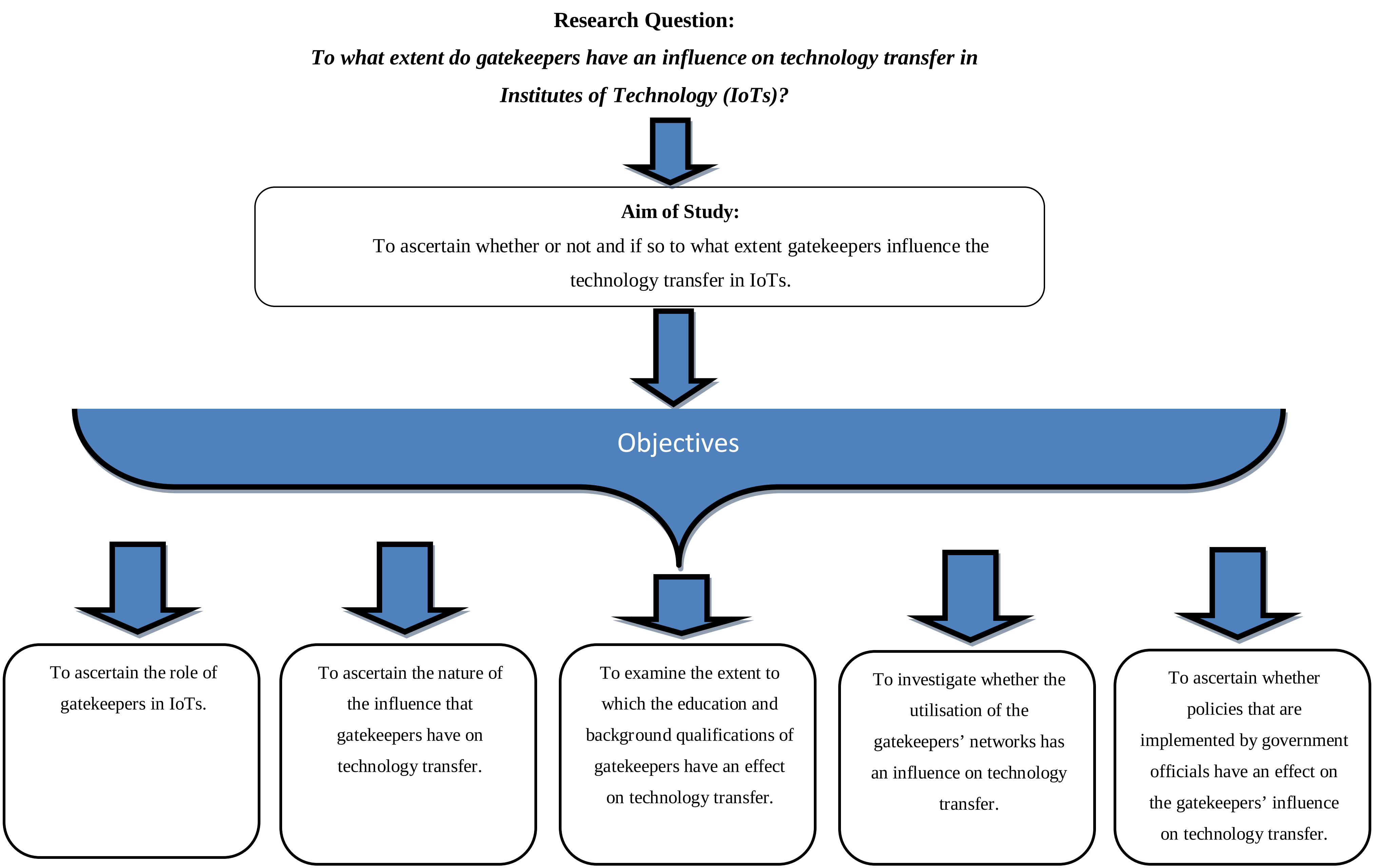

Figure 1.1 Research Questions, Aim and Objectives (Source: Current Research)

This research was conducted using a qualitative methodology within an interpretative philosophical stance. Rice and Matthews (1995) indicated that business incubation centres were the hub of technology transfer. It would therefore, be reasonable to expect on the basis of their research that incubation centres located in IoTs in Ireland would also be the hub of technology transfer. In order to obtain a representative sample of IoT incubation centres, a set of selection criteria was complied. Phone calls were made to the incubation managers of the 14 IoTs in Ireland to obtain results for the criteria. A total of six IoTs were then selected to be part of the study. In research by Duff (1994) it was inferred that if incubation centres were the hub of technology transfer then consequently, the incubation centre managers would be gatekeepers of the technology transfer process. This prompted the researcher to interview the six incubation managers in more depth. However, in contrast to research by Duff (1994) this study established that the six incubation managers, while considering themselves to be facilitators of the technology transfer process, did not view themselves as gatekeepers and instead identified 23 individuals who they considered gatekeepers of technology transfer. Therefore, even though the incubation centre managers play an important role in technology transfer, they are not necessarily the technology transfer drivers in their IoTs.

During the course of interviewing the 23 individuals identified as gatekeepers in the IoTs it became apparent that they were not satisfied regarding the policies that government funding agencies enforced. Consequently, this researcher also interviewed 10 key government employees in government funding agencies in Ireland. As the government is now looking for a return in the investment it has made through the commercialisation of research, this study examines whether the policies implemented by government funding agency employees have an impact on technology transfer processes in IoTs. Chapter 4 contains a detailed description of the methodology employed in this study.

1.4 Conceptual Framework

The conceptual framework (Figure 1.2) was derived from identifying the concepts, stating the propositions and identifying the interpretations underpinning this research. The focal point of this research study is the potential impact of gatekeepers on technology transfer in IoTs. As mentioned previously, Allen (1977) believed that gatekeepers possessed the ability to transfer knowledge effectively which as Garud and Nayyar (1994) added is needed for technology transfer to be successful. Therefore, Figure 1.2 examines the areas that impact on gatekeepers' ability to affect technology transfer. These areas are technology/knowledge transfer, role of gatekeepers in knowledge transfer, their absorptive capacity, networking and implementation of government policies.

As mentioned previously, the research question is seeking to ascertain the influence that gatekeepers have on technology transfer in IoTs, consequently there are certain areas of literature which will be informative to the study and subsequent solution to the research question. For example, Garud and Nayyar (1994) stated that technology transfer would not occur without individuals who actively gather and transfer knowledge throughout the organisation. Therefore, it could be deduced that individuals are needed to transfer knowledge in order for technology transfer to be successful. Knowledge transfer can only be effective and successful when an organisation possesses an organisational culture that supports employees in order for them to understand, gather and translate vital knowledge being transferred (Goh, 2002). Furthermore, Goh (2002) believed that an organisational culture that encompassed attributes in leadership, trust, collaboration, support structures and absorptive capacity would have an impact on knowledge creation. Consequently, this being the case it would seem that an organisation requires a culture that supports knowledge transfer and a design that encourages networking and communication which is paramount for the effective transfer of knowledge. Moreover, if Goh (2002) believed that these key activities are essential for knowledge transfer then it can be deduced from analysing literature that individuals are needed for this to occur thereby, supporting Garud and Nayyar's (1994) view that individuals were needed to transfer knowledge. Authors such as Allen (1977) confirmed the importance of individuals to knowledge transfer and identified organisational gatekeepers as important to the process as they source information externally and disseminate it to other employees that require such information.

Many authors such as Whitley and Frost (1973) and Balbridge and Burnham (1975) were of the opinion that gatekeepers were the primary linking mechanism to external sources of information and that this information existed in an organisation because of the networking activities of gatekeepers. Through the examination of literature on networking and gatekeepers' networks the study will investigate the relationship between technology transfer in IoTs and the network composition and utilisation by gatekeepers. While gatekeepers utilise their networks to access information it is also important that they are able to absorb this information and translate to those who require it (Cohen and Levinthal, 1990; Zahra and George, 2002). Cohen and Levinthal (1990) were of the opinion that individuals i.e. gatekeepers were important within an organisation as they had the expertise to gather translate and disseminate knowledge. Consequently, this study asks how gatekeepers utilise their network contacts in order to increase technology transfer activity (See Figure 1.2).

Furthermore, technology transfer, within higher education institutes, can also be hindered by certain polices and strategies that are introduced by government agencies. This was commented on by Lillis (2007) and Hazelkorn and Moynihan (2010) who were of the opinion that universities and IoTs have been treated differently in policy, funding and recognition due to the complicated binary system of education that exists in Ireland. Reasons cited in literature for this gap will be discussed in Chapter 2. Therefore, this study will examine whether government policy has an impact on research activity in IoTs and if this has any influence on gatekeepers' ability to increase technology transfer in IoTs (See Figure 1.2).

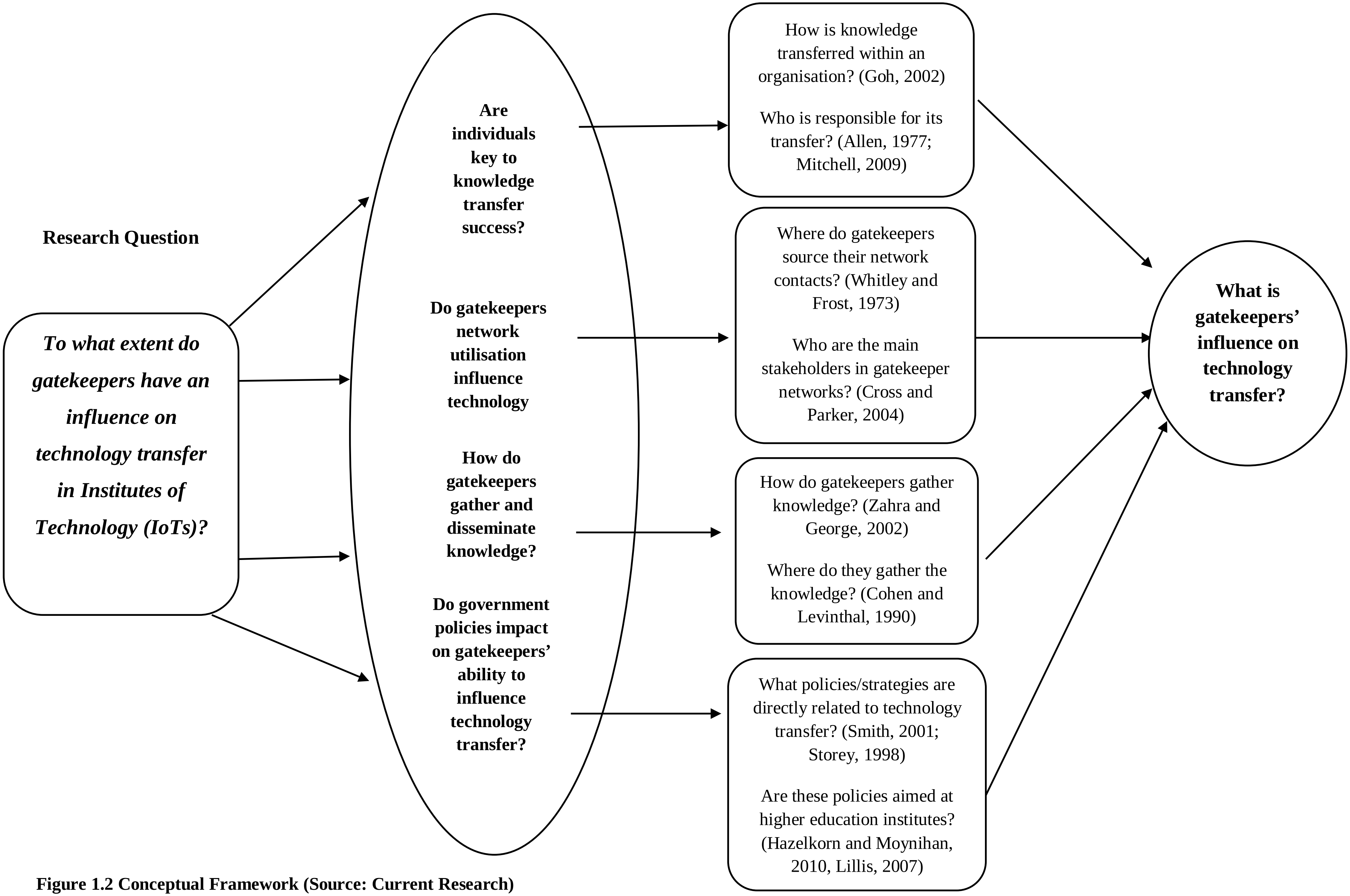

Figure 1.2 Conceptual Framework (Source: Current Research)

1.5 Contribution to Knowledge

This study contributes to the growing body of literature on technology transfer. Based on previous literature it was identified that technology transfer required knowledge to be transferred in order to be effective and that knowledge transfer required the existence of individuals to disseminate knowledge in order to be effective. Therefore, it can be justified that individuals are needed in order to progress the technology transfer process. Through the examination of technology transfer, as depicted by Friedman and Silberman (2003), it has been established from this current study that the TTO requires assistance from gatekeepers in IoTs in order to find quality academic faculty to engage with them and share their ideas. The process, in IoTs, involves the motivation and influence of gatekeepers on the academic community to file invention disclosures and share their knowledge with industry. This research, therefore contributes to the literature on technology transfer by establishing the influence of gatekeepers on technology transfer.

A second contribution to knowledge this study makes is its investigation of the impact of individuals on an organisational culture that facilitates knowledge transfer amongst its employees (Allen, 1977; Goh, 2002). A final contribution to knowledge this study makes is its examination of the impact of policies enforced by government funding employees on gatekeepers' ability to encourage technology transfer in IoTs. An examination of this impact is one way of addressing whether or not the policies that are implemented by government funding agency employees hinder gatekeepers' ability to motivate the academic community to engage in technology transfer.

1.6 Thesis Chapter Outline

The thesis comprises of eight chapters, the structure of which is graphically depicted in Figure 1.3. Chapter 1 outlines the direction of the study. It provides background information on the research topic and outlines the research objectives which underline the thesis in addition to the contribution to knowledge on the technology transfer made by the thesis.

Chapter 2 examines the binary system of education that exists in Ireland and the areas of research that IoTs engage in. The chapter also examines the differences that exist between universities and IoTs regarding the allocation of research funding.

Chapter 3 provides theoretical references and the academic foundation for this study. The chapter defines technology transfer and provides an overview of the technology transfer process model developed by Friedman and Silberman (2003). The chapter also outlines the role that knowledge transfer has in the process. This is because it is accepted that as Garud and Nayyar (1994) suggest, technology transfer cannot exist without the existence of individuals to gather and disseminate knowledge. The chapter reviews literature regarding gatekeepers and their influence in organisations. Various studies illustrate how gatekeepers possess the capacities of effective knowledge transfer such as leadership, trust, support structures, collaboration and absorptive capacity. The literature review also investigates the topic of networks and social networks, particularly in the way that gatekeepers utilise network contacts to obtain and transfer knowledge. Absorptive capacity theory is also investigated in this chapter. This section of the literature review examines research by authors such as Cohen and Levinthal (1990) and Zahra and George (2002) as to the absorptive capacity of individuals and their ability to gather and disseminate knowledge within an organisation. Government policy and its impact on the ability of gatekeepers to motivate academic faculty to engage in technology transfer is also reviewed.

Chapter 4 describes the methodology adopted in the study. This chapter outlines the philosophical stance of the study and justifies the epistemological and methodological position of the researcher in light of the research objectives of the study. The chapter also describes the primary research approach taken by the researcher which included semi-structured interviews. It also outlines the strategies and techniques employed in analysing the research data.

Chapter 5 analyses the data collected for the research study. The data is examined under the major themes arising from the study namely the gatekeepers' influence on the technology transfer process, the impact of the skills gained from gatekeepers' education and experience on the technology transfer process and the gatekeepers' utilisation of networks in their role in the technology transfer process.

Chapter 6 analyses the relationship between IoTs and government funding agencies and the consequent impact on the technology transfer process. The chapter also analyses the perceived differences in the defined roles of universities and IoTs and the influence of the metrics utilised by government funding agencies on the technology transfer process.

Chapter 7 provides a discussion of the key findings stemming from Chapter 4 with references to the literature. The most significant themes that arose from the research are discussed, in particular the impact of gatekeepers' education and experience on their influence on the technology transfer process, the gatekeepers' belief that technology transfer would not happen without their existence and the IoTs' confusion as to their role in the research and innovation process.

Chapter 8 provides conclusions for the study including the theoretical contributions to the literature on technology and knowledge transfer. Also in this chapter the researcher describes the main limitations of this research and provides recommendations for future studies as a follow up of this investigation.

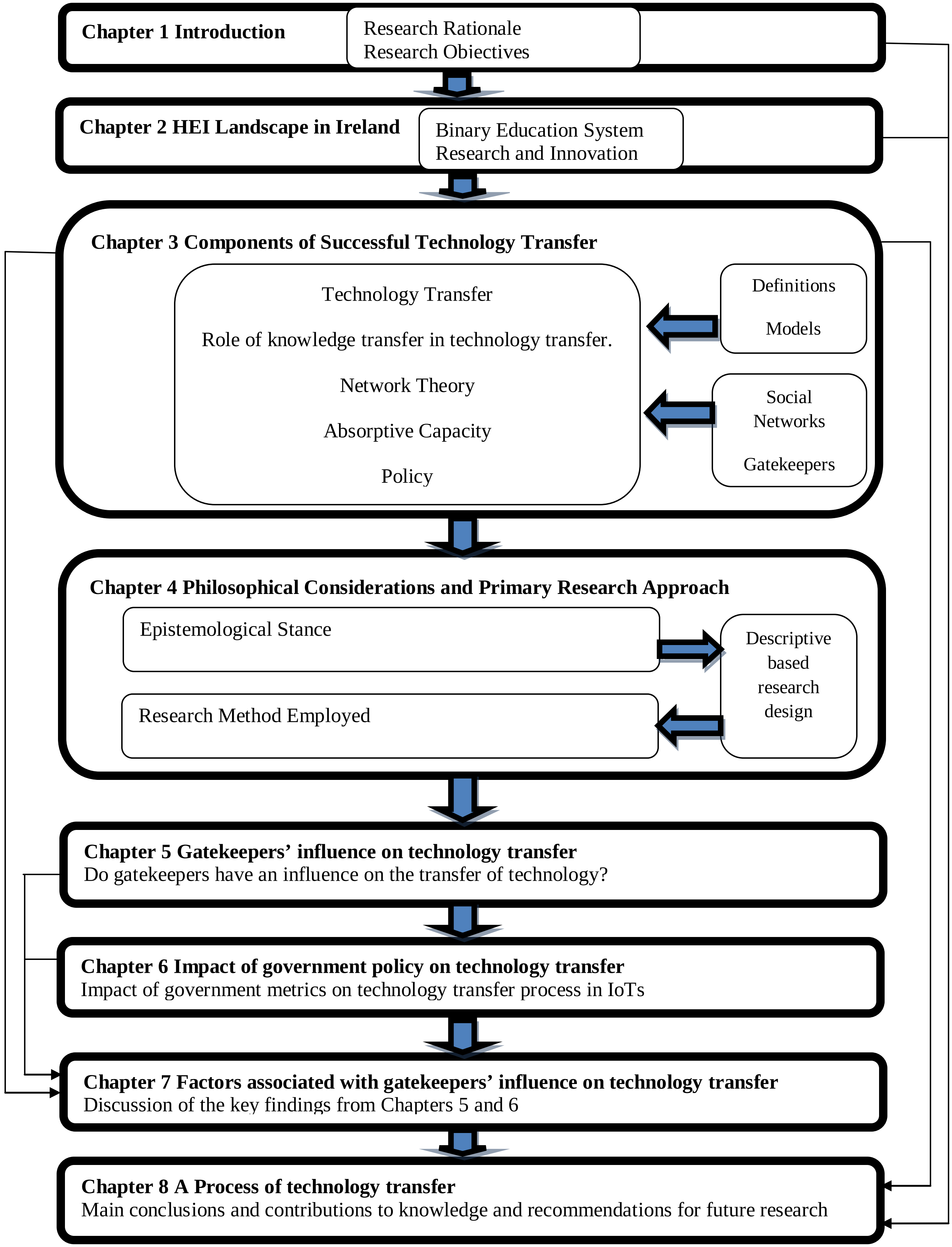

Figure 1.3 Structure of Thesis (Adapted: from McGrath, 2009)

1.7 Chapter Summary

This chapter introduced the reader to the main theme of this thesis, which is to investigate the extent of the influence of gatekeepers on the technology transfer process in IoTs. It outlined the rationale behind this research including the research question, aims and objectives. Finally a summary of the presentation of the thesis was provided. The next chapter examines the education system that exists in Ireland.

Chapter 2:
HEI Landscape in Ireland

2.1 Introduction

As was mentioned in Chapter One the main focus of this research is gatekeepers' influence on technology transfer that occurs in the Institute of Technology sector in Ireland. Irish higher education is generally described as a binary system. It is however, more complex and varied than the term usually suggests (Skilbeck, 2003). There are seven universities, 14 IoTs, nine Colleges of Further Education, the National College of Art and Design and other national institutions (Coate and Labhrainn, 2009; Hazelkorn and Moynihan, 2010). In particular, the universities and IoTs have been treated differently in policy, funding and recognition and since their inception in the 1970s; IoTs have had different missions and objectives than universities. The IoT sector was set up initially to facilitate the education of industry workers while universities have always been viewed and respected as research institutions. However, over the years the role of IoTs has evolved to include becoming more involved in research and commercialisation. Despite this slight change in position of IoTs their status regarding the allocation of funding and operation has continued to remain in their original function of regional technical colleges (RTCs).

Therefore, in order to justify the reasons for focussing on only one part of the binary education system, this chapter reviews the evolution of the higher education sector in Ireland. The chapter also examines the differences that exist between universities and IoTs regarding areas such as funding for research and their role in the education system. The next section of this chapter discusses the evolution of the higher education system that exists in Ireland.

2.2 Evolution of the Higher education system in Ireland

When examining the history of the Irish Education System, it is important to note that Ireland did not always have a binary education system. Education was viewed as a place for those with money and mainly for the men of society. Prior to the 1970s higher education in Ireland was dominated by five universities (Hazelkorn and Moynihan, 2010). This resulted in many working class people not being able to further their education. Cardinal John Newman founded the Catholic University of Ireland in 1854 and was regarded as one of the strongest proponents of the ideals of liberal education. In effect his ideal was that while the university would cultivate the intellect of young gentlemen through the sharing of knowledge, it would not necessarily pursue a critical paradigm or the production of new knowledge (Readings, 1997; Blackmore, 2001). In response to the publication of Technician Training Ireland (OECD, 1964) and Investment in Education (OECD, 1965), the government concluded that there was an urgent need to produce technically qualified people in order to plan for industrial development.

The term ‘Free Education’ was formed as a result of these publications (Garvin, 2004). The Minister for Education in the 1960s, Donough O’Malley believed that as a result of unemployment and emigration problems, Ireland now more than ever needed to concentrate on its education system. As a result of O’Malley’s ideals, vocational and technical education was expanded with the establishment of Regional Technical Colleges (RTCs). The RTCs were defined as educating for trade and industry over a broad spectrum of occupations ranging from craft to professional level, notably in engineering and science, but also in commercial, linguistic and other specialities (Government of Ireland, 1967). RTCs were set up with the primary function to supply distinctive vocational, technical and sub-degree provisions on a regional basis. In effect, the establishment of these colleges meant that Cardinal Newman’s ideal of higher education being for the rich of society was left behind and a new era in further education in training became a mass phenomenon (McGinley and Donoghue, 2001).

In the 1990s the RTCs were re-designated as Institutes of Technology (Lillis, 2007). This re-designation occurred in somewhat controversial circumstances (Hazelkorn and Moynihan, 2010). It occurred officially in recognition of the RTCs university-level teaching and research but unofficially because the classification of ‘Institute of Technology’ was perceived as having higher status. However, it is important to note that Dublin Institute of Technology was never an RTC and can award degrees up to doctoral level (Coate and Labhrainn, 2008). The remaining IoTs receive their validation from the Higher Education Training and Awards Council (HETAC).

Figure 2.1 illustrates the location of each of the seven universities and 14 IoTs located in the Republic of Ireland.

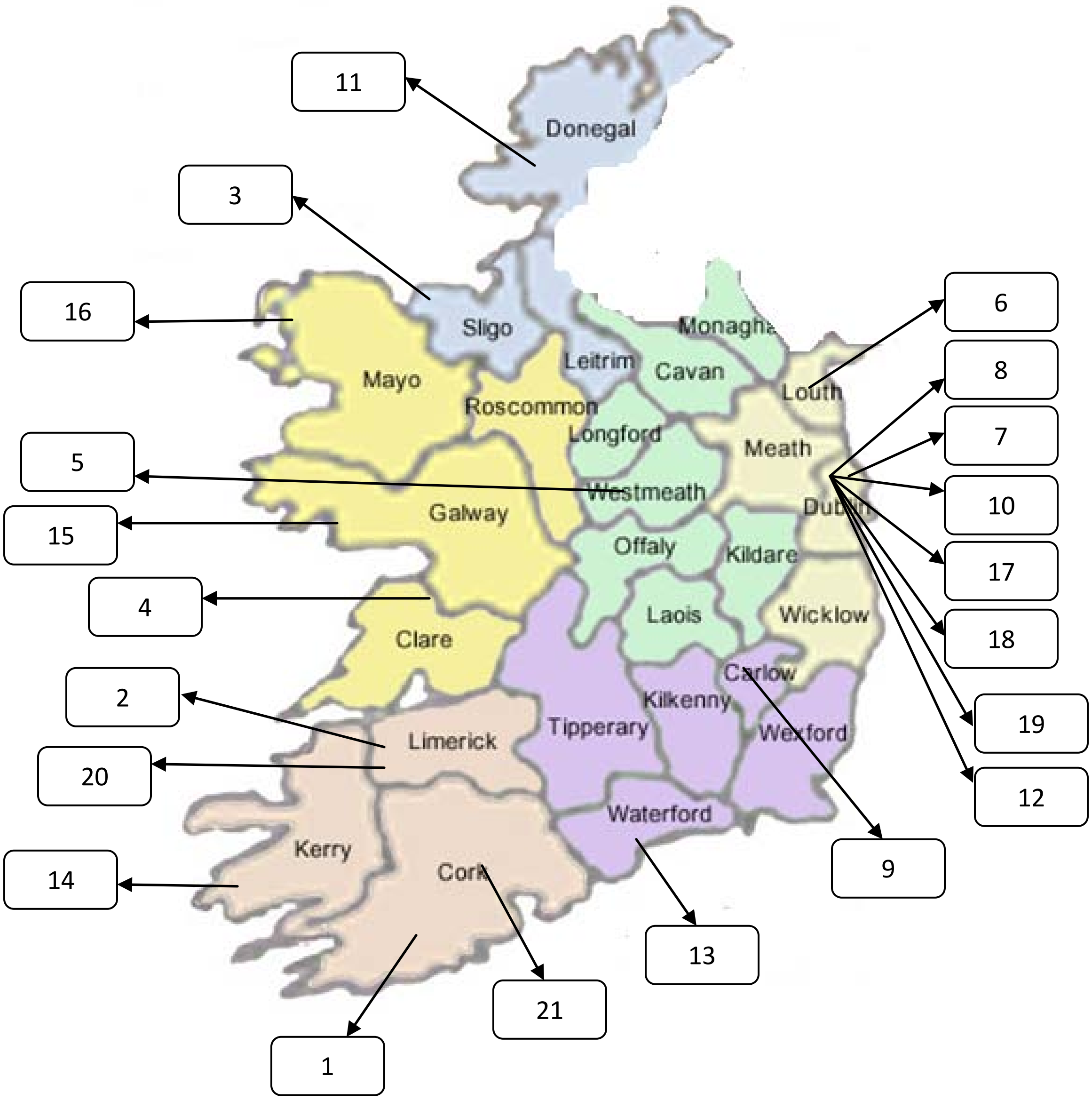

Figure 2.1 Universities and IoTs in the Republic of Ireland (Source: Current research)

Number	University
15	National University of Ireland (Galway)
16	National University of Ireland (Mayo)
17	Trinity College
18	University College Dublin
19	Dublin City University
20	University of Limerick
21	University College Cork

Table 2.1 List of Universities in Republic of Ireland (Source: Irish Universities Association).

Number	Institute of Technology (IoT)
1	Cork Institute of Technology
2	Limerick Institute of Technology
3	Sligo Institute of Technology
4	Galway-Mayo Institute of Technology
5	Athlone Institute of Technology
6	Dundalk Institute of Technology
7	Dublin Institute of Technology
8	Blanchardstown Institute of Technology
9	Carlow Institute of Technology
10	Tallaght Institute of Technology
11	Letterkenny Institute of Technology
12	Dun-Laoghaire Institute of Art and Design
13	Waterford Institute of Technology
14	Tralee Institute of Technology

Table 2.2 List of IoTs in Republic of Ireland (Source: Institutes of Technology Ireland).

As mentioned previously the IoTs were established with the mission of contributing to the technological, scientific, commercial, industrial, social and cultural development of the state. As can be seen from Tables 2.1 and 2.2 Dublin has the most IoTs in the country with four and also has three of the seven universities located in Ireland. Regional economic development is a key aspect of government policy in Ireland, and the Institutes of Technology play an important role in regional innovation processes and thus economic development. The IoTs represent an important resource to the regional economy because of their excellence in industrial links. Their multi-regional location and openness to working with industry provides a platform upon which real industrial impact can be built upon (SSTI, 2006). However, despite the IoTs' importance to the regional economy and industrial links, there are still gaps in the way that IoTs are treated when compared to universities in areas such as funding and their governance. These issues are examined in more detail in section 2.3 below.

2.3 Differences that exist between Universities and IoTs

The OECD (2006) criticised the Irish government for its over-dependence on the development of university research and innovation and its resulting lack of unified strategy for the whole of the higher education sector (universities and IoTs). The HEA strategy document (2008) acknowledged that a national strategy for the sector was required and highlighted that the Irish government had a lack of true vision as to the future directions of its binary education system. In a review of the education system in Ireland, the OECD (2004) commented on the existence of the binary system. The report strongly recommended that some diversity was maintained through the distinctive (vocational, sub-degree) roles of the IoTs, but that the government needed to establish a more unified steering mechanism for the whole sector. However, despite this recommendation from the OECD for a more integrated system, IoTs have always been treated differently to the university sector. This is most recognisable in areas such as government policies towards research i.e. technology transfer, the amount of capital that is allocated for research funding and most importantly their recognition as institutes that can produce world class research.

The governance of both the university and IoT sector gives further credence to the diversity that has become synonymous between the two sectors. The university sector is and has always been governed by the Higher Education Authority (HEA) (Clancy, 1989). However, the IoT sector, when it was founded in the 1970s, was funded and governed by the Department of Education – not the HEA – yet the HEA was given the function of advising the government on the development of the entire sector (Osborne, 1996). Finally, in 2006 the IoTs came under the remit of the HEA as a result of the recommendations from the OECD (2006) report on the higher education system in Ireland.

While both sectors were previously separated by their governance there are still distinct differences that separate both IoTs and Universities such as the types of programmes offered, the qualifications given to students and the number of students located in both sectors. The university sector has always been and continues to be considerably larger than the IoT sector and is expanding rapidly. Recent figures from the HEA (2011) suggest that of the total 161,631 students enrolled in higher education in 2011 61% were enrolled in universities and 39% in IoTs. Six IoTs had fewer than 3000 full-time students. The ever increasing gap between universities and IoTs is being even more defined by the universities' aim to distinguish themselves as 4^{th} level or postgraduate level providers and IoTs as the undergraduate providers (IUA, 2007).While post graduate enrolment is increasing in the IoTs, the sector still only has 13% of the postgraduate population while universities have 87% (HEA, 2011).

As competition for students, finance and reputation accelerates, the gap between universities and IoTs is widening. According to Hazelkorn and Moynihan (2010) and Lillis (2007) recent data on who goes to college confirms that as demographic changes take effect and the entry of students to college decreases this has resulted in more and more pressure being added to IoTs. Some programmes are unable to recruit sufficient students, a difficulty which is likely to become more acute in the current financial environment, a situation which does not seem to affect the university sector. Literature by Flynn (2007), Walsh (2007) and Fitzgerald (2006) suggests that students are choosing universities over IoTs which is increasing socio-economic stratification. This gap is more evident in postgraduate education and even more prevalent in the PhD cohort.

The gap in research funding between universities and IoTs, while it has decreased in recent years there is still a significant difference in the capital that is allocated to each sector. This gap is partly influenced by the government policies that articulate the functions of both universities and IoTs. For example, in 1997 it confirmed by the University Act that research was an unqualified function of universities stating that a university shall promote and facilitate research. In contrast, from an IoT perspective, in 1967 the Steering Committee on Technical Education's report on education in Ireland did not specify research as a fundamental function of the education system although both the RTC Act (1992) and DIT Act (1992) acknowledged this role subject to such conditions as the Minister may determine. Given the universities' status and reputation they have been able to attract investment to support massive capital building projects across their campuses. From the beginning of 2008, all HEA funded HEIs were funded under the recurrent grant allocation model which was based on the number of students and metrics tied to research performance and activity outputs (HEA, 2008). This is a significant change from when 30% of university budgets were allocated to research and development based on estimates of academic research activity while IoTs were funded by the Department of Education and Science on the number of hours lectured. As a result of these inequalities, universities have traditionally been more successful. The current economic recession that has occurred in Ireland has also widened the gap on the already historic differences in funding between universities and IoTs. This was further emphasised by Hazelkorn and Moynihan (2010), where they stated that this historical gap still exists and is only further widened by the Irish government's decision to introduce budget and employment restrictions to cope with public sector deficit.

This consequently delayed the development of further research activity in the IoTs (Hazelkorn and Moynihan, 2010). The authors further stressed that due to infrastructural inequalities that have developed over time, universities have been significantly more successful at obtaining research funding both nationally and internationally through proposal submission. While IoT research income ranged from €191,000 to €9.1m in comparison university funding ranged from €14.3m to €60.5m (Forfas, 2007; IoTi, 2008; Hazelkorn and Moynihan, 2010). In contrast, IoTs are allocated the majority of their funding from Enterprise Ireland (EI) and the Department of Education and Science. These agencies base their funding allocation on a targeted metric system used to measure technology transfer in IoTs As a result of this method of funding through measurement of technology produced in IoTs the majority do not qualify for research funding. The main barrier being that many IoTs do not have the facilities to engage in this type of activity nor do they have the expertise or people to help support and drive research. Furthermore, according to Hazelkorn and Moynihan (2010) many academics with the IoT sector do not possess enough time to dedicate to technology transfer as they are contracted to lecture 16 hours a week, prepare for classes and correct exams which does not leave much time to do in depth research.

Due to the fact that the funding given to HEIs by the government is decreasing as a consequence of the current economic environment, the HEIs are now relying on European funding to maintain their research and enable more research to be completed by academics and students. Table 2.3 summarises the key figures from the IoTs and universities as regards EU funding complied by the

Irish Universities Association (IUA) (2007). As can be seen from Table 2.3, the seven universities in Ireland are represented and it is evident that they receive a lot more funding than the 14 IoTs. Only four of the IoTs managed to make this list. The differences between universities and IoTs regarding the allocation of funding is given further credence as the table also shows that TCD received more funding on its own than all four of the funded IoTs combined. So not only are there clear divisions between funding allocation to IoTs and universities nationally, it also extends into European funding. It is this type of situation that has caused dissatisfaction in the IoT sector as the IoTi (the main representative body for 14 of Ireland's Institutes of Technology) have stated that it is unfair to expect the IoTs to make an impact on research and innovation in Ireland when they are not receiving the funding and guidance from the Irish government.

Higher Education Institution	Acronym	University/IoT	EU Funding Received (Euros)
Trinity College Dublin	TCD	University	14,035,129
University College Cork	UCC	University	10,550,713
University College Dublin	UCD	University	10,045,132
National University of Ireland Galway	NUIG	University	7,264,577
University of Limerick	UL	University	6,143,017
Dublin College University	DCU	University	2,328,046
National University of Ireland Maynooth	NUIM	University	974,600
WIT	WIT	IoT	4,461,733
DIT	DIT	IoT	563,372
CIT	CIT	IoT	317,050
GMIT	GMIT	IoT	246,560
IT Tallaght	IT Tallaght	IoT	-
Sligo IT	Sligo IT	IoT	-
Dundalk IT	DKIT	IoT	-
LIT	LIT	IoT	-
Blanchardstown IT	Blanchardstown IT	IoT	-
Tralee IT	Tralee IT	IoT	-
Athlone IT	Athlone IT	IoT	-
Letterkenny IT	Letterkenny IT	IoT	-
Carlow IT	Carlow IT	IoT	-
Dun Laoghaire IT	Dun Laoghaire IT	IoT	-

Table 2.3 Higher Education Institution Funding (Source: Irish Universities Association, 2007)

2.4 IoTs, research and funding

Now more than ever before, Ireland must concentrate on its indigenous industry base and its highly skilled graduates who are capable of adapting to and competitively exploiting existing and new knowledge (McDonagh, 2009). The education system plays a vital role in the strengthening of the current economy and relationships with the industry sector are important in order to boost academic-industry relationships.

The strengthening of the economy is partly reliant on research that is evolving from the higher education sector and IoTs especially have a key role to play as engines of growth for the SME sector due to their closeness to industry. While it has been suggested that the role of IoTs in research was set to take on increased importance in the coming years (Lillis, 2007), there has been no official research policy that relates specifically to IoTs although there are references in the underpinning legislation and other documents that IoTs should focus on applied research with a regional focus (Lillis, 2007; Hazelkorn and Moynihan, 2010). There seems to be cross communication between what the IoTs and their representatives feel they should be doing and what the government policies state they should focus on. The IoTi research plan 2011-2015 stated that it was a focus of the governing body to increase the capacity of IoTs to engage in the management of intellectual property, commercialisation and transfer to industry (IoTi, 2011) while, the government does not view IoTs on par to universities with regard to research activity and commercialisation.

Part of the reason for this view is that IoT academics are contractually obliged to lecture 560 hours per year or 16 hours per week which is often re-interpreted by some academics and their trade unions as only doing 16 hours work per week (Hazelkorn and Moynihan, 2010). Furthermore, the working week consists of 37.5 hours and while academics only lecture 16 of those hours they also require time for preparation of lectures, correction of assignments and supervision of student theses thereby, hampering the actual amount of research i.e.: technology transfer being undertaken IoTs. This consequently, reflects on the IoTs' efforts in being seen as research institutions by government funding agencies as academics are not provided with the time and resources to concentrate fully on research activities.

Despite the lack of time that IoT academics have to commit to technology transfer, the IoTi (2011), the governing body for the IoTs, stated that the IoT sector performed important technology transfer activity in the following main areas:

- Information Communications Technology (ICT) research incorporating telecommunications and software technologies
- Health and Bio-technology incorporating all areas of life and biological sciences
- Energy and the Environment incorporating all aspects of renewable, sustainable and environmental research

- Physical and Chemical Sciences and Engineering incorporating medical devices, engineering and materials
- Humanities, Social Sciences and Business incorporating digital media and creative arts
- Enterprise Support and Business Creation

The IoTi (2011) report also highlighted that between the years 2006 and 2010 the IoT sector had received €218m in research funding of which 66% was allocated to ICT, Health and Bio-technology sectors. In total ICT research accounts for 28% of research and innovation (R&I) activity in IoTs, the health and bio-technology sector accounts for 38% of R&I activity while energy and environment accounts for 11% of research activity in the IoT sector. Approximately 9% of IoT research and innovation activity is associated with chemical sciences and engineering with social sciences and business account for 7% of research activity in the IoT sector. Furthermore, the report stated that research in business incubation and enterprise support accounts for 8% of research activity in the IoT sector (IoTi, 2011). Despite the increased figures in research activity, Hazelkorn and Moynihan (2010) stated that research activity the Irish higher education system remains at a crossroads as these figures are only a small proportion of the resources that universities receive to engage in similar activities.

Progression of research activity in IoTs and the funding of such research is constrained by the historical binary system of education that exists. It is also as a result of circumstances and unresponsive to changing national and global requirements, low levels of internationalisation and weak governance and strategic leadership. This system has caused IoTs to struggle with their brand and identity with industry choosing to partner with universities rather than IoTs while many students choose to attend universities due to the social and cultural capital attached to university qualifications (Hazelkorn and Moynihan, 2010). Furthermore, the funding system that is currently in place simply rewards existing strengths and experience and is widening the gap between IoTs and universities. Therefore, while it can be stated that IoTs are crucial to strengthening research and innovation within Ireland it seems that the current complex binary system that exists in Ireland is damaging to IoTs in areas such as funding, recognition and governance (Hazelkorn and Moynihan, 2010).

2.5 Chapter Summary

This chapter introduced the reader to the binary system of education that exists in Ireland. It outlined the development of the higher education system and the diversity that exists between IoTs and universities, in particular the funding that is allocated to the sector. The next chapter examines the literature that informed the research.

Chapter 3: Components of Successful Technology Transfer

3.1 Introduction

The purpose of this chapter is to review the literature that has informed this research. As was stated in Chapter 1 the purpose of this study is to investigate the influence of gatekeepers on technology transfer in IoTs. Much of the literature on the role of gatekeepers has been written from an industry perspective and it is interesting to note that the existence of gatekeepers and their role in the technology transfer process in the HEI sector has not received as much attention in literature to date. As mentioned in the previous chapter the Irish higher education system is known as a binary system which consists of 14 Institutes of Technology (IoTs) and seven universities. The majority of this literature review describes the university side of technology transfer processes however, it is important to note that the issues relating to universities are general issues that can relate to all HEIs including IoTs.

In order to explore whether gatekeepers influence the technology transfer process from an IoT perspective, this chapter examines certain key aspects of literature such as (1) technology transfer theory and the process associated with it (Friedman and Silberman, 2003), (2) the literature on knowledge transfer and its role in the technology transfer process incorporating the theories on absorptive capacity and networks, (3) the function of gatekeepers in the technology transfer process including how literature suggests that gatekeepers can be the knowledge transfer instrument of the technology transfer process and vital to the successful transfer of technology and (4) the impact of government policy on the success of the technology transfer process.

The first section in the literature review examines technology transfer theory and its process as defined by Friedman and Silberman (2003). Technology transfer cannot exist without individuals to assist in the transfer of knowledge (Garud and Nayyar, 1994). Therefore, the role that knowledge transfer plays in the technology transfer process is also explored incorporating Goh's (2002) characterisation of social dimensions of successful knowledge transfer. According to Goh, knowledge transfer is only effective when an organisation possesses a culture that supports collaboration, a high level of trust, leadership and absorptive capacity amongst employees. Goh

(2002) believed that these key activities were needed in order for knowledge transfer to be effective therefore it can be deduced from reading Goh's research on effective knowledge transfer that individuals are needed for its success. These individuals have been defined as gatekeepers by researchers such as (Allen, 1977). This chapter therefore, examines the role of gatekeepers within and outside of an organisation and their consequent affect on knowledge and technology transfer.

As the transfer of knowledge is needed for technology transfer to be successful, this chapter investigates literature pertaining to absorptive capacity. Absorptive capacity has been defined by Cohen and Levinthal (1990) as an organisation's ability to assimilate, disseminate and exploit outside knowledge, in effect the ability of an organisation to transfer knowledge. Goh (2002) concluded that when encouraging knowledge transfer, an organisation has to ensure that its employees have the capacity to absorb the necessary knowledge and disseminate it throughout the organisation. This chapter also analyses the functions of gatekeepers and explores the role they have in the organisation and if they have an influence on technology transfer. This section of the literature review will also assess the impact that gatekeepers may or may not have in an organisation in particular in their use of network contacts (Allen, 1977).

Networks and network theory are also analysed as a key area of literature in this research. Previous research has found that technology transfer activity can increase because of the networking interactions amongst individuals in an organisation. Oliver and Liebeskind (1998) believed the gathering and disseminating of new information via network contacts of individuals has an influence on the technology transfer process. Social network theory including the four types of individuals within an organisation, identified by Cross and Parker (2004), are also examined.

Finally, the last section of this literature review focuses on the impact of government policy on the technology transfer process. The implications of government policy regarding technology transfer on communities and societies and their subsequent impact on higher education technology research strategies (Carlsson and Fridh, 2002) are investigated. Evidence from Smith (2001) suggested that HEIs not engaging in research activity were viewed as unproductive by government funding agencies. As a result of this outlook, HEIs not engaging in sufficient research were viewed as not being eligible for research funding from the government. Smith

(2001) also suggested that this outlook on research funding had an impact on the research decisions by HEIs. Section 3.2 of the literature review investigates technology transfer and the process model developed by Friedman and Silberman (2003).

3.2 Technology Transfer

Technology is information that is put to use in order to accomplish some task while the transfer is the movement of technology via some communication channel from one individual or organisation to another (Carayannis, Kassicieh and Radosevich, 1997). Technology transfer usually involves several sources of technology which is transferred to a target group of receptors who do not possess those specialised technical skills and who therefore, cannot create the technology themselves (Carayannis *et al.*, 1997).

Technology transfer has also been referred to as the intersection between industry and academia resulting in the licensing of inventions or intellectual property from academic research to industry (American University of Technology Managers (AUTM), 1998). Research by Santos and Rebolledo (2006) into the management of technology transfer offices (TTOs), found that technology was transferred through oral communication and through the licensing of intellectual property. Research into the technology transfer process that occurs in higher education institutions by Siegel, Waldman and Link (2003) and Cunningham and Harvey (2004) concluded that licensing was the most common method of measuring technology transfer. In reviewing literature pertaining to HEIs, technology transfer is described as flowing from universities to the industrial sector (Parker and Zilberman, 1993) and facilitating the commercialisation of academic research (Berneman and Denis, 1998). Cunningham and Harvey (2004) also stated that the interaction between industry and HEIs was an important facet in the transfer of technology and it was vital to ensure that proper communication channels existed between the two. Nikulainen (2007), through a survey sent to 1002 individuals in the Finish nano community and the types of academic faculty that supplied this industry with information, supported Cunningham and Harvey's (2004) concept when he defined technology transfer as the active, informal and formal interaction between university researchers and companies which included both codified and tacit types of knowledge. For the purpose of this research Nikulainen's (2007) definition of successful technology transfer has been adopted as it takes into consideration the impact that faculty and researchers in HEIs have on the process of technology transfer. The subsequent sections discuss the methods of measuring technology transfer and also the main elements of the technology transfer process.

3.2.1 Measuring Technology Transfer

Spann, Adams and Souder (1995), in their study of government methods of allocating funding based on technology transfer activity, concluded that studying metrics of technology transfer is an important research and practical pursuit. According to the authors, government technology transfer programmes, in America, are continually expected to increase the rate of their transfer and to quantify the effectiveness of their transfer programmes. As mentioned in Chapter 2, this has also become the main focus of government funding agencies in Ireland, where HEIs are allocated funding based on their response to technology transfer metrics set out by agencies such as Enterprise Ireland. Through the Technology Transfer Strengthening Initiative set up by Enterprise Ireland in 2006 a number of metrics were established to enable the measurement of technology transfer activity amongst the HEIs. These important metrics include the number of patents, licenses, spin-outs and invention disclosures produced by higher education institutions, the results of which are used to benchmark the best performing HEIs and allocate further research funding (Enterprise Ireland, 2009).

3.2.2 Technology Transfer Model

The purpose of this research is to establish the nature of the influence of individuals on technology transfer. Models such as the Contingent Effectiveness Model from Bozeman (2000) draws on the assumption that parties to technology transfer have multiple goals and effectiveness criteria. However, while the underlying principle of this model infers that certain impacts of technology transfer can be understood in terms of who is doing the transfer, how they are doing it, what is being transferred and to whom, it was concluded by Nikulainen (2007) that the model disregards the individual characteristics of people and their role and influence on technology transfer.

The Friedman and Silberman (2003) model described technology transfer as flowing from invention disclosures to jobs and wealth however, in contrast to Bozeman's (2000) model the authors believed that one of the main determinants of the successful filing of academic invention disclosures to the technology transfer office (TTO) was greater awards for academic faculty involvement in the process (Friedman and Silberman, 2003). The TTO is responsible for patenting an invention disclosure is conveyed by the academic community. The authors suggested that the greater the rewards for academic faculty involvement in technology transfer the more commercially viable an institute's inventions would be. The authors also acknowledged that faculty quality influenced the rate at which invention disclosures were available for licensing.

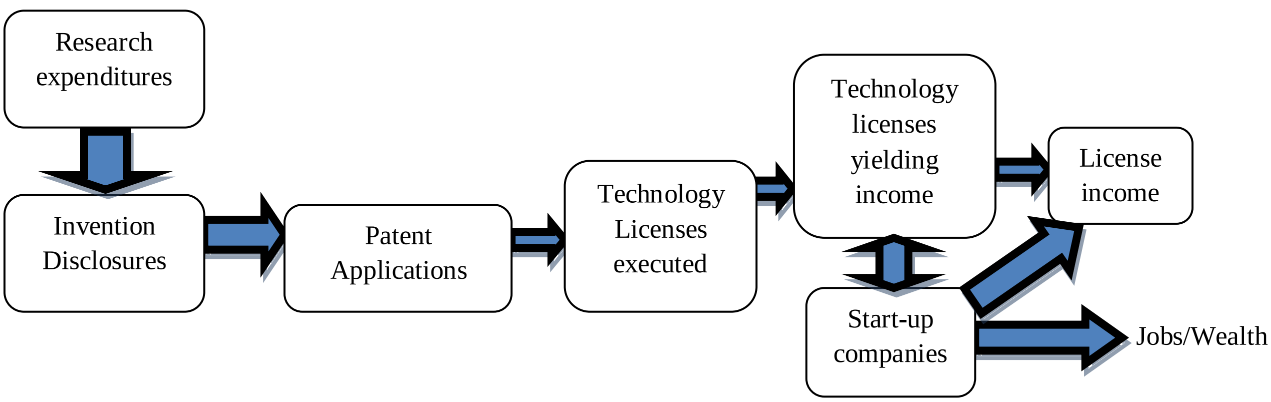

Figure 3.1: Technology Transfer Process within higher education institutes (Source: Friedman and Silberman, 2003, p.18).

Friedman and Silberman (2003) described the technology transfer process in universities as the license of academic inventions through to their eventual commercialisation and the passage of knowledge generated by academics to a company allowing it to obtain a commercial competitive advantage. Figure 3.1 illustrates that the technology transfer process starts with an invention disclosure which according to Siegal, Waldman and Link (2003) can result in a start-up company being formed and sometimes eventual spin-out company. Ledbetter and Zipkin (2002), in their research into venture returns in corporate spin-outs, defined spin-out companies as a venture that is supported by another entity (often by a university as part of a technology transfer program) in return for a considerable share in the company with Lockett, Wright and Franklin (2003) adding that successful technology transfer within a university ultimately resulted in spin-out companies being formed. According to Bercovitz and Feldman (2003) by filing an invention disclosure the institute faculty members provide the raw materials for higher education institute intellectual property.

Following on from the invention disclosure being filed, the next step in the process is patent application which includes the legal protection granted to the owner of an invention or process (Forfas, 2004; Cunningham and Harvey, 2004). Cunningham and Harvey (2004), in research into the strategic management of technology transfer within the higher education sector, suggested that the patenting system provides a means for inventors to protect the fruits of their labour and in turn attract more funding. However, Plonski (2000) found the amount of patents that occur in higher education institutes depended on the amount of inventions that are disclosed by the academic faculty and submitted to the institute.

The next step in the technology transfer process is the execution of technology licensing agreements which involve selling the right to use HEIs' inventions in return for revenue (Cunningham and Harvey, 2004) and is believed to be the most crucial output of technology transfer (Siegel, Waldman and Link, 2003). Furthermore, the OECD (2006) stated that licenses can be granted for the use of patented technologies, technologies with a patent pending and for unpatented technologies. The final stage of the technology transfer process involves the negotiation of the license agreement (Friedman and Silberman, 2003). These agreements can include benefits to the higher education institute such as royalties, sponsored research agreements or an equity stake in a new venture based on a licensed technology (Cunningham and Harvey, 2004). These authors also noted that the technology transfer process typically included a set of components starting with investment in research and development and ending with the introduction of a product/service to the market. However, Siegal, Waldman and Link (2003), in research into the productivity of technology transfer offices in five research universities, noted that the technology transfer process is a lot more complicated than was depicted by Friedman and Silberman (2003), believing that the model by Friedman and Silberman placed too much emphasis on patenting when in actual fact technology can be licensed prior to the patenting process.

Cunningham and Harvey (2004) acknowledged that for the technology transfer process to occur academic faculty and industry need to work together for mutual gain. Many technology transfer models in literature such as Gibson and Slimor (1991), Rebentisch and Ferretti (1995) and Bozeman (2000) focus purely on the operational functions of the technology transfer process mainly from an industry perspective which is why the Friedman and Silberman (2003) model is referenced by many researchers such as Cunningham and Harvey (2004) and Yusof and Jain (2007). The reasoning for this is because the Friedman and Silberman (2003) model takes into account the process from a higher education institute perspective which correlates with Cunningham and Harvey (2004). While Friedman and Silberman (2003) do acknowledge the existence of a TTO to organise and manage the process of invention disclosure generation to commercialisation, the authors do recognise that technology transfer success is determined by the availability and willingness of academics to share their knowledge. It has become clear that technology transfer is a staged process running from invention disclosures to wealth. However, knowledge has to be transferred to the academic community in order for the process to exist (Garud and Nayyar, 1994). Therefore, it is also evident that the technology transfer process in HEIs, depicted by Friedman and Silberman (2003), relies on the TTO's ability to encourage and engage the academic community to transfer their knowledge. It involves the interactive relationships that connect the functional activities of basic research, applied research, development, diffusion, adaptation, and dissemination into an overall technology delivery system (Feller, Madden, Kaltreider, Moore and Sims, 1987). Therefore, if examined from a higher education perspective the exchange of knowledge by academic faculty is essential in the successful transfer of technology.

Friedman and Silberman (2003) investigated the presence of incentives for academic community to engage in technology transfer activity and whether this made a difference to the amount of technology license income that was generated in a HEI. The authors found HEIs that provided greater rewards for faculty involvement in technology transfer would generate more licenses and royalty income. It was also found that a HEI's ability to generate technology transfer and income sometimes depended on the relationship between academic faculty and the industrial sector (Lee, 1996). Thursby and Thursby (2002) further added that regardless of the amount of resources and quality of faculty within an institute, technology transfer will not be achieved without the disclosure of an academic invention i.e. the transfer of knowledge. However, in order to encourage academic faculty to engage in technology transfer and share their knowledge, certain individuals are needed in order to motivate, inspire and lead faculty to share knowledge.

3.2.3 Education and Experience of individuals and their influence on the interaction of the academic community in technology transfer

Bercovitz and Feldman (2003), in their study of technology transfer within academic departments in Duke and John Hopkins universities, documented that faculty and the academic community will be more engaging in technology transfer if they are influenced by the following three categories of interaction amongst individuals: Training interaction, Chairman interaction and Cohort interaction effects.

Regarding training interaction, academic faculty who had experience in training and working at institutions where participation in technology transfer was accepted and actively practiced had an expectation of continuing this practice (Bercovtiz and Feldman, 2003). The training interaction theory correlated with previous research by Manski (2000) who stated that a faculty member may be influenced by prior experience and training through observing the actions of others in their professional network. In part, individuals can become skilled in areas of technology transfer through the observation of other individuals disclosing their inventions (Bercovitz and Feldman, 2003). Venkataramen (1997), and Shane (2000), whilst researching individuals engaging in entrepreneurship activities, emphasised that individuals who have acquired a broad knowledge base and obtained both professional and academic degrees were more likely to engage in and inspire others to engage in technology transfer. While individuals with interdisciplinary educational backgrounds and expansive prior knowledge were better positioned to recognise and act upon innovative ideas (Shane, 2000).

Regarding chairman interaction effects, Bercovitz and Feldman (2003) found that an individual may adjust their expectations relative to those in leadership roles. Therefore, by being active in technology transfer the chair (leader) sends a signal that technology transfer is a valid activity and thus leads by example. This was previously emphasised by Cohen and Levinthal (1990) where they stated that individuals who possessed experience in multiple theoretical perspectives in their professional role were more apt to be skilled in responding to diverse information and sending signals to their followers that technology transfer is a valid activity.

Finally the cohort interaction effect shows that learning activity is more likely to occur within a cohort of peers (Glaser, Sacerdote and Scheinkerman, 1996; Duflo and Saez, 2000 and Sorensen, 2001). By observing the behaviours of others who have similar experiences and status, individual expectations may change towards engaging in technology transfer activities (Bercovitz and Feldman, 2003). It is expected individuals will be more likely to engage in technology transfer activities when they observe individuals with similar characteristics within their departments who are also disclosing their inventions (Bercovitz and Feldman, 2003; Friedman and Silberman, 2003). Similarly in institutions that have a long established and relatively successful technology transfer process, the academic community is more likely to disclose their inventions. Individuals would not be able to observe or understand the technology transfer process in their institutions without other members of faculty i.e. leaders showing them how to do so. Therefore, it is the ability of leaders in the institution to gather and disseminate relevant knowledge which affects the capability of individuals to understand the information being transferred (Kotter, 1990).

3.3 The role of knowledge transfer in the technology transfer process

Technology transfer includes a range of formal and informal co-operations between technology developers and those that are seeking to use the technology. In addition, technology transfer involves the transfer of knowledge and technical know-how as well as physical devices and equipment. Literature suggests that the relationship between knowledge and technology is both complex and subject to much interpretation and often so intertwined that any mention of one implies the other (Li-Hua, 2000). Evidence from research into the transformative capacity of developed technology over time by Garud and Nayyar (1994) found that some researchers contend that technology is a form of knowledge, as technology not only consists of machines and mechanical equipment, but also comprises of technical knowledge and contributor skills (Scott, 1992). Gopalakrishnan and Santoro (2004) argued that while clearly linked, knowledge and technology are distinct constructs exemplifying different activities. The authors stated that technology is about knowing how things are done while knowledge is about knowing why things occur. Bohn (1994) proposed a framework for measuring stages of technological knowledge within an organisation and concluded that knowledge is more about 'why' and includes elements of human judgment and is more tacit than technology.

Knowledge can be divided into tacit and explicit knowledge (Nonaka, 1998). Tacit knowledge consists of technical skills that are informal and also consists of individual mental modals, beliefs and perspectives. Brennenraedts, Bekkers and Verspagan (2006) added that tacit knowledge is embedded in people and therefore lacks physicality and accessibility. This is in contrast to explicit knowledge which is objective and quantifiable and transferred without the presence of people (Nonaka, 1998; Brennenraedts, Bekkers and Verspagan, 2006). Explicit knowledge can flow between HEIs and industries and can consist of patents, scientific articles and books. In other words explicit knowledge can be tacit knowledge that has been identified, recorded and made understandable and accessible to other people (Nonaka, 1998). Maitland (1999) further argued that the crucial factor in determining a company's competitive advantage is its ability to convert tacit knowledge into explicit knowledge through organisational learning. Allen (1977), in his study of 19 engineers and their ability to acquire and disseminate technical information, stated that an organisation's ability to convert tacit knowledge into meaningful and useable information was due to the existence of certain individuals within an organisation that have the ability to decode that knowledge. These individuals constitute a small number and are frequently turned to for information as they are at the core of the information network. These people resolve the problem of cultural homogeneity and provide functions of meaning translation, trust building and tacit-explicit conversions (Rees, 2007).

Birkinshaw (2001), following research into resolving knowledge management problems in leading companies such as HP, Ericsson, ABB and Xerox, stated that successful knowledge transfer depends on the people/persons involved in the process and the capacities and networks that they possess. Riege (2007) added that effective knowledge transfer is more than the movement of useful knowledge from one location to another; knowledge transfer should assist with collaborative problem solving between people which is also supported by networks.

Therefore, organisations that do not have individuals to decode and translate the relevant knowledge may not be successful in technology transfer.

There are certain key factors that an organisation needs to consider in order to develop effective knowledge transfer. Goh (2002) stressed that previous studies only dealt with the transfer of knowledge from one organisation to another and not how knowledge was transferred within an organisation. Goh (2002) proposed in order for knowledge to be transferred successfully an organisation needed a culture that supported its employees in understanding the knowledge being transferred. Goh (2002) suggested that knowledge transfer requires the willingness of employees to transfer and share knowledge which implies that unless an organisation’s employees show a level of co-operation and collaboration, knowledge will not get transferred. Positive relationships and ease of communication have to be developed between parties in order for knowledge transfer to be effective (Figure 3.2). A high level of trust is also required and essential in order for employees to collaborate and this trust can be acquired as a result of the presence of leaders within an organisation. Employees also require support structures provided by the organisation so that they are able to understand the knowledge that is being transferred. These support structures can come in the form of policy documents or strategy documents. Absorptive capacity of employees is also essential in order for them to understand the knowledge being transferred. This in turn can affect the success of knowledge transfer.

Each of Goh’s (2002) knowledge transfer capacities for organisations are examined in the next section of this chapter. Figure 3.2, adapted from Goh’s (2002) effective organisational knowledge transfer model, illustrates how the factors in knowledge transfer are interrelated and impact on the process. Successful technology transfer requires, not only the transfer of technology but, the actual transfer of knowledge from one person to another (Feller, Madden, Kaltreider, Moore and Sims, 1987). Therefore, it can be inferred that successful knowledge transfer ultimately results in successful technology transfer (Garud and Nayyar, 1994). The following sub-sections investigate Goh’s (2002) capacities of successful knowledge transfer.

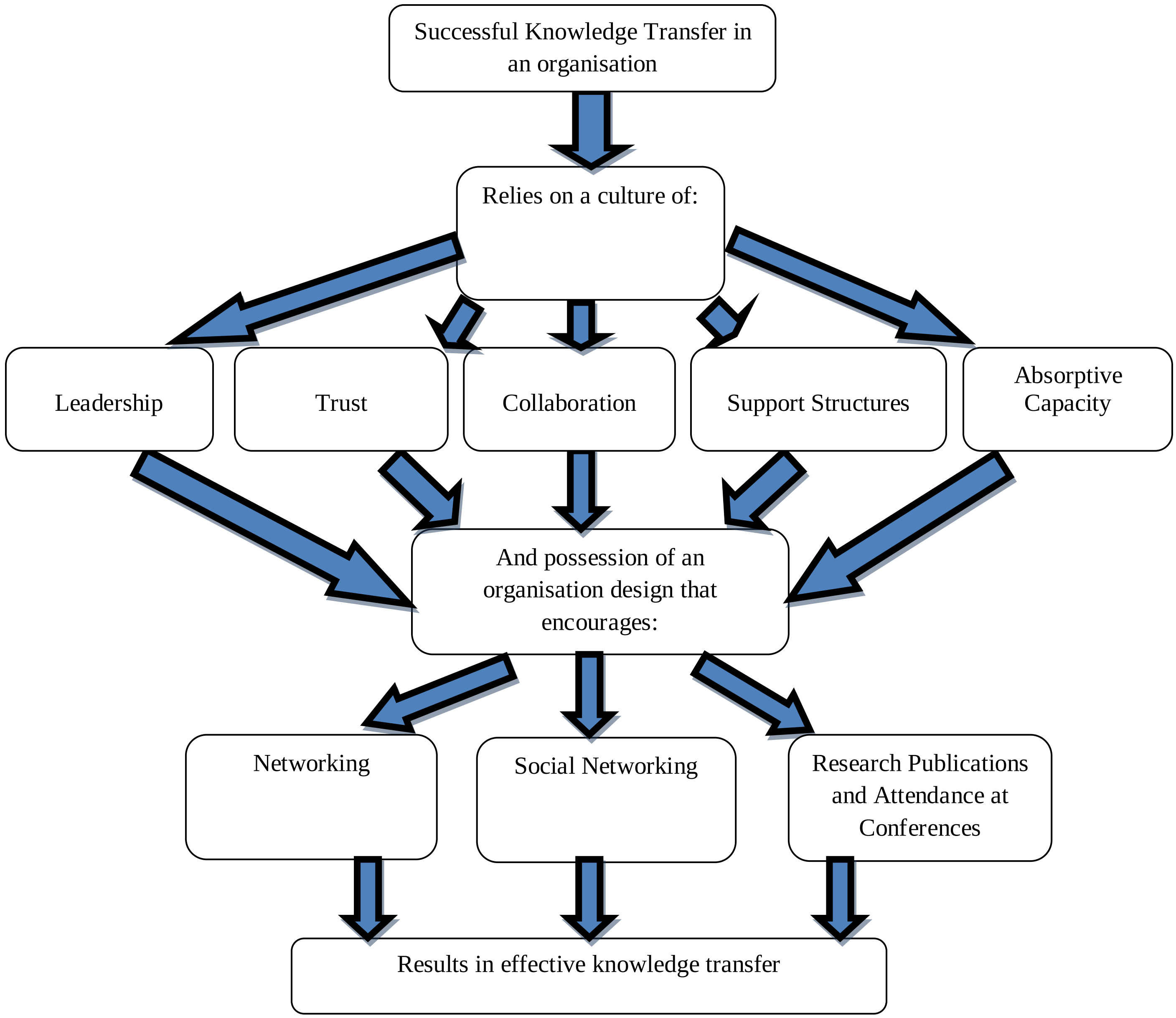

Figure 3.2: Components of successful technology transfer (Source: Adapted from Goh, 2002).

3.3.1 Leadership

According to Kotter (1990) the elements of successful leadership in an organisation require the alignment of people, creation of teams and the motivation and inspiration of people to overcome barriers. According to Goh (2002), based on research into the critical success factors for implementing knowledge management in small and medium enterprises, leaders within an organisation have a major influence on the organisational culture and support structures needed to engage people in sharing their knowledge. Furthermore, leaders have an important role in establishing some key conditions required to facilitate knowledge transfer (Goh, 2002). For example, effective leadership within an organisation can encourage collaboration and sharing of knowledge and information amongst individuals. More importantly effective leadership can increase the propensity of employees to participate in the transfer of knowledge (Goh, 2002). Bercovitz and Feldman (2003) concurred with Goh (2002) and were of the belief that active leaders in technology transfer send signals that the process is a valid activity and therefore, encourage others to participate through their leadership skills. Maak and Pless (2006), in research into responsible leadership in an organisational setting, agreed with the importance of the role of leadership in knowledge transfer and stated that it was crucial in order to build, cultivate and sustain relationships both inside and outside the organisation and more importantly in achieving a meaningful shared vision.

Zheng (2007), based on research into teacher professional development in the Chinese Mainland was of the opinion that, in order to remain competitive in the global marketplace, an organisation must make deliberate efforts to monitor and influence the flow of knowledge internally, as well as to other organisations. This requires individuals with leadership skills to gather and disseminate the relevant knowledge to others in an organisation. Zheng (2007) stated that good leadership tends to follow distinctive patterns. Leadership involves the relationship between the leaders and followers, reaches beyond formal authority, develops in times of need and requires individual perception along with the application of that perception. Leadership is developing a vision for the future and strategies for producing the changes needed to achieve that vision (Kotter, 1990). Kotter continued by stating that leadership helps bridge the communication gap or information barrier that often is associated with obstacles to the dissemination of knowledge in an organisation. Leaders are also effective in facilitating individuals to understand and believe the vision and strategies of the organisation by communicating what is needed to the people involved.

People with leadership roles also tend to have management roles within the organisation (Kotter, 1990). Etzioni (1964), in his work on modern organisations, was of the opinion that the power of an organisation to control its members rests in specific positions of power such as head of department. The power and influence of individuals in an organisation (Kotter, 1990) centres around the theory that leadership is based on the formation of relationships between people rather than on the abilities of a single person. In other words the network interaction between individuals is shaped by the power and influence emanating from the leader(s) in an organisation. The primary function of leadership is to generate and manage change. The direction setting aspect of leadership does not produce plans; it creates vision and strategies (Bennis and Nanus, 1985). However, in order for these visions and strategies to be realised, a high level of trust is needed between leaders and work groups in the organisation for people to follow their example and engage in technology transfer. Trust in leaders by employees in an organisation results in the widespread sharing of and ready access to information and is also one of the key components of successful knowledge transfer (Goh, 2002).

3.3.2 Trust

Trust is a very complex concept and has many definitions (Rousseau, Sitkin, Burt and Camerer, 1998). The authors, in an analysis of shared understandings of trust across disciplines such as economics, psychologists and sociologists, were of the opinion that there had been no universally accepted scholarly definition of trust. However, an agreement did exist as to its importance in the enabling of collaborative behaviour (Gambetta, 1998); promoting adaptive organisational forms such as networking (Miles and Snow, 1992); and reducing conflict and facilitating the formation of work groups (Meyerson, Weick and Kramer, 1996). Rousseau *et al* (1998) defined trust as follows: *"Trust is a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behaviour of another"* (p.1998).

Hong-Park (2006), in their research into the role of trust in a virtual environment in the ICT sector, stated that while trust is a complex concept, it is also important to note that there is a clear distinction between interpersonal and organisational trust. Interpersonal trust is where the trustee is another individual. The target of interpersonal trust is the person, thus it is not based on their position, title, or because they represent an organisation. In contrast organisational trust is when the trustee is an organisation not an individual. A key characteristic of trust is that without trust, knowledge transfer is difficult, since the risk and uncertainty is high for the exchange of intellectual capital (Boon and Holmes, 1991; Handy, 1995; Gambetta, 1998; Jones and George, 1998). Hong-Park (2006) also proposed that trust can be increased amongst individuals through socially embedded communication links, where a group of people combine and exchange their knowledge, which as a result generates new knowledge.

According to Goh (2002) a high level of trust is required between individuals and work groups in an organisation for new knowledge to be shared. Trust is also a relevant factor in the area of leadership as the leaders need to be open in order for individuals within the organisation to confide and trust in them and vice versa. Within knowledge-intensive environments knowledge creation is a source of sustainable competitive advantage among practitioners as well as researchers (Nonaka, 1991, 1998; Pfeiffer, 1992). Therefore, sharing knowledge is one way of creating new knowledge (Nonaka and Takeuchi, 1995).

However, individuals are cautious of sharing their knowledge especially when there is a probable threat that others may take advantage of their information. This is particularly relevant from a HEI's perspective where technology transfer will only occur when academic faculty and representatives from business and industry work together to share their knowledge (Cunningham and Harvey, 2004). Trust between academic faculty and industry personnel is needed to find mechanisms to manage the inherent conflict between openness, the characteristics of the world of academia and the privacy/secrecy issue that belongs to the industrial community. However, due to the contrasting missions and cultures of industry and higher education institutes, they tend not to co-exist as natural business partners. Sanchez and Tejedor (1995), following research into university-industry relationships in Spain, found that industry managers rated their relationship with higher education faculty of little benefit due to the impeding impact of the cultural barrier and the distrust between the two parties. Lambert (2003) agreed with the summations of Sanchez and Tejedor (1995) and stated the different cultural missions of industry and academia equated to academics valuing their freedom.

This incongruence was given further credence by Graff, Heiman, Zilberman, Castillo and Parker (2002) who stated that HEI faculty value academic freedom and publication of their research. The industrial sector, on the other hand, is motivated by a clear product driven focus and a culture that emphasises secrecy and protection through the issue and application of patents (Nelson, 2001). Trust between the two parties is therefore, hard to implement as HEIs and industry often operate on different timescales, have different objectives to fulfil and often have different value systems (Elmuti, Abebe and Nicolosi, 2005). Finding the appropriate balance to satisfy both academia and industry is a significant challenge. In essence, trust is essential for knowledge to be effectively transferred within organisations and also facilitates collaboration amongst individuals. Therefore, as stated by Goh (2002), an organisation that has a culture that promotes trust amongst its employees will find it easier to transfer knowledge and gain the trust of their employees. Furthermore, leaders within an organisation and who are trusted possess the ability to disseminate knowledge to organisational employees and engage them in knowledge transfer activities.

3.3.3 Collaboration

Research has shown that industry-university collaboration usually takes place within four important components: research support, cooperative research, knowledge transfer and technology transfer, with the two most important components being knowledge and technology transfer (Santoro, 2000). Knowledge transfer activities are usually seen as a good foundation for future collaborations between organisations. Technology transfer aims to integrate university-driven research into applied research initiatives for the development and commercialisation of new processes and products. Goh (2002) stressed that a strong and pervasive culture of co-operation and collaboration had to exist in an organisation in order for knowledge to be transferred as effectively as possible. Goh (2002) further stressed that organisations that promoted active collaboration amongst its employees with external parties would show that this was a viable activity to other employees of the organisation and encourage those individuals to participate in the collaboration process. Collaboration is developed through work practices that encourage and allow individuals and groups to work together on projects and problems. Trust amongst individuals is essential for collaboration to occur (Goh, 2002) as it will increase the propensity of employees and teams to collaborate and share relevant knowledge and information. However, establishing a collaborative and co-operative climate in an organisation will not improve knowledge transfer on its own; there is also a need to foster a culture of problem seeking and problem solving.

Leaders can play a role within the culture of problem seeking, problem solving and collaboration. Leaders within an organisation encourage a culture of experimentation and serve as role models for this desired behaviour. They are not defensive about problems and can admit to mistakes, and they take a problem-solving and collaborative approach to both concepts (Goh, 2002). A strong culture of experimentation together with high trust and a collaborative and co-operative climate will have a positive influence on knowledge transfer activities amongst others within an organisation. Thus culture can significantly increase the propensity of an organisation's employees to share knowledge and information freely with each other (Goh, 2002).

Regarding collaboration between HEIs and industry, Poyago-Theotoky, Beath and Siegal (2002), in research into the potential drawbacks to the rise in university-industry partnerships, added that interaction between education and industry depends on the contribution and the motivation between both parties. According to Lee (2000) the primary motive for firms to collaborate with higher education institutes is access to new knowledge and the primary motive for institutes to collaborate with industry is the allocation of funds for equipment and research assistants. Based on research by Schartinger, Schibany and Gassler (2001) into the relations between universities and innovative firms in Austria, it was found that organisations pursue policies that encourage collaboration with higher education institutes. A possible motivation for collaborating with universities is the access to problem-solving capabilities (Schartinger *et al*., 2001) and access to state of the art knowledge and technology and the prestige that comes with the association with such collaborations (Geisler and Rubenstein, 1989). Schartinger *et al*., (2001) also argued that access to state of the art science and complementary know how, outsourcing of R&D and cost reduction as well as access to research networks were motivators for firms to engage in collaborations with universities. Universities, on the other hand collaborate with industry for various different reasons which include access to scientific resources, the exposure of students to practical problems and the potential employment opportunities for graduates (Schartinger *et al*., 2001).

3.3.4 Support Structures

Another important factor in effective knowledge transfer within an organisation is the appropriate infrastructure to reinforce and provide support structures to employees within the organisation (Goh, 2002). According to Bartlett and Ghoshal (1998) and Szulanski (2000) knowledge can become *sticky* in organisations that do not have proper support structures to ensure its dissemination to employees. Von Hipppel (1994) stated that to solve a problem the necessary knowledge and problem solving capabilities must be brought together at a single point. When this knowledge is costly to acquire, transfer and use it is deemed to be sticky. Essentially, knowledge is embedded in human action, interactions and practices. Therefore, in order to manage sticky knowledge innovation actors (individuals) are required to remove the barriers to knowledge transfer (Wang and Lu, 2007). Wang and Lu (2007), in their research into a strategic framework of successful knowledge transfer in the development of university-industry interactions in China, further discussed that the interactivity of individuals helped reduce the cultural differences and knowledge gap between universities (knowledge generation) and industries (knowledge production) (Nonaka, 1994).

While the sharing of knowledge is essential it is important that both industry and higher education institutes have the necessary knowledge capacity i.e. support structures that are put in place by an organisation so that knowledge can be disseminated effectively (Goh, 2002). Even if knowledge is freely available and disseminated within the organisation the organisational employees must have the necessary skills to be able to apply the information to avoid the presence of knowledge stickiness (Szulanski, 1996). A solution to this would be to increase horizontal communication flows. This can take many forms and may take time to accomplish. One approach is to encourage cross functional teams and teamwork in an organisation. Therefore, leaders within the organisation should facilitate the introduction of networking and teamwork amongst the employees in the organisation and encourage the effective transfer of knowledge. This encourages individuals to begin learning and communicating horizontally. Another organisational support structure is the introduction of a reward system. This was emphasised by

Bartlett and Ghoshal (1998) in their study into strategic planning in insurance and investment start-up companies and how it could increase individual expertise and organisational learning. They suggested that one way to encourage knowledge transfer was to base rewards on more than just financial success. Rewarding financial success only results in lack of knowledge sharing. Therefore, measurement and reward systems that favour a more balanced system that takes into account collaboration amongst individuals will encourage more effective knowledge transfer. According to Davenport and Prusak (1998), in research into the ability of an organisation to manage knowledge through the utilisation of knowledge generation, codification and transfer, measurement and reward systems can play a critical role in encouraging knowledge transfer amongst individuals in an organisation.

In essence, appropriate structures and processes may be put in place but employees need an opportunity to use them. The organisation needs to free up time for them to engage in these support structures and processes. This suggests that organisations design, the structure of the reward system and the availability of time as a resource can give further impetus to effective knowledge transfer. Employees need to be trained in using new technologies and maximising its potential to increase communication and information sharing (Goh, 2002) and this is where leaders in the organisation can provide and facilitate appropriate support structures to other members of the organisation. Training, by leaders in the organisation, in problem solving and group interaction can help increase the transfer of knowledge in an organisation. Therefore, employees need to be supported to ensure that they are trained proficiently in being able to gather and disseminate and decode all knowledge that is given to them in an organisation. The employee also needs to have adequate time to learn and translate these skills in an organisation.

Support structures such as tenure of an academic faculty member are also relevant in the effective transfer of knowledge. Tenure of an academic spent within an organisation increases understanding of organisational routines and the support structures that are in place in an organisation (March and Simon, 1958). Therefore, according to Zenger and Lawrence (1989) members of the organisation look for support and communication with others whose tenure in the organisation is at least as great as their own, particularly because useful advice, suggestion and knowledge specific to the organisation are likely to be obtained from those individuals with long tenure. Hence, knowledge is more effectively transferred because of the support structures available such as time, tenure of organisational members and the management of knowledge stickiness. Figure 3.3 illustrates that absorptive capacity of employees within an organisation is also a factor in the effectiveness of knowledge transfer (Goh, 2002).

3.3.5 Absorptive Capacity

There have been many attempts to define absorptive capacity, for example Cohen and Levinthal (1990) suggested that the term related to an organisation's ability to identify, assimilate and exploit outside knowledge. It is important to note that the discussion on the absorptive capacity of organisations also applies to organisations such as HEIs. Research by Cohen and Levinthal into 1719 business units in 318 firms in 151 lines of business found that an organisation's absorptive capacity does not simply depend on an organisation's direct interface with the external environment, it also depends on the transfer of knowledge across and within the organisation that may be quite removed from the original point of entry. Cohen and Levinthal continued by stating that a firm's absorptive capacity depends on the individuals who stand at the interface of either the firm or the external environment. Kim (1997) emphasised that absorptive capacity involved the capacity to learn and solve problems while Zahra and George (2002) agreed with Cohen and Levinthal and defined absorptive capacity as a set of organisational routines and procedures through which organisations acquire, assimilate, transform and exploit knowledge to produce a dynamic organisational capacity.

Goh (2002) stated that when encouraging the transfer of knowledge, an organisation has to ensure that both parties in the transfer process have the necessary knowledge base (absorptive capacity) to learn, and to understand each other. The knowledge gained in the transfer needs to be shared within the organisation. Therefore, leaders within the organisation are important as they have the ability to identify, gather and absorb knowledge and disseminate it to those in the organisation that need it. A positive relationship between individuals and ease of communication between them eases the absorptive capacity ability of both parties (Goh, 2002). Organisations absorptive capacity will depend on the absorptive capacities of its individual members; therefore, in order to increase an organisation's absorptive capacity, investment must be made in the individual employee.

Zahra and George (2002) advanced Cohen and Levinthal's (1990) definition of absorptive capacity in an organisation and identified four different but complementary dimensions of absorptive capacity: acquisition, assimilation, transformation and exploitation (See Figure 3.3). Zahra and George (2002), in their review and extension of absorptive capacity theory, stated that absorptive capacity is not a one dimensional concept, consisting rather of various skills and dimensions. According to Zahra and George these components have some commonalities across different firms and are idiosyncratic in the specific ways firms pursue, develop and employ them. This variability provides firms with a basis to develop different types of competitive advantage.

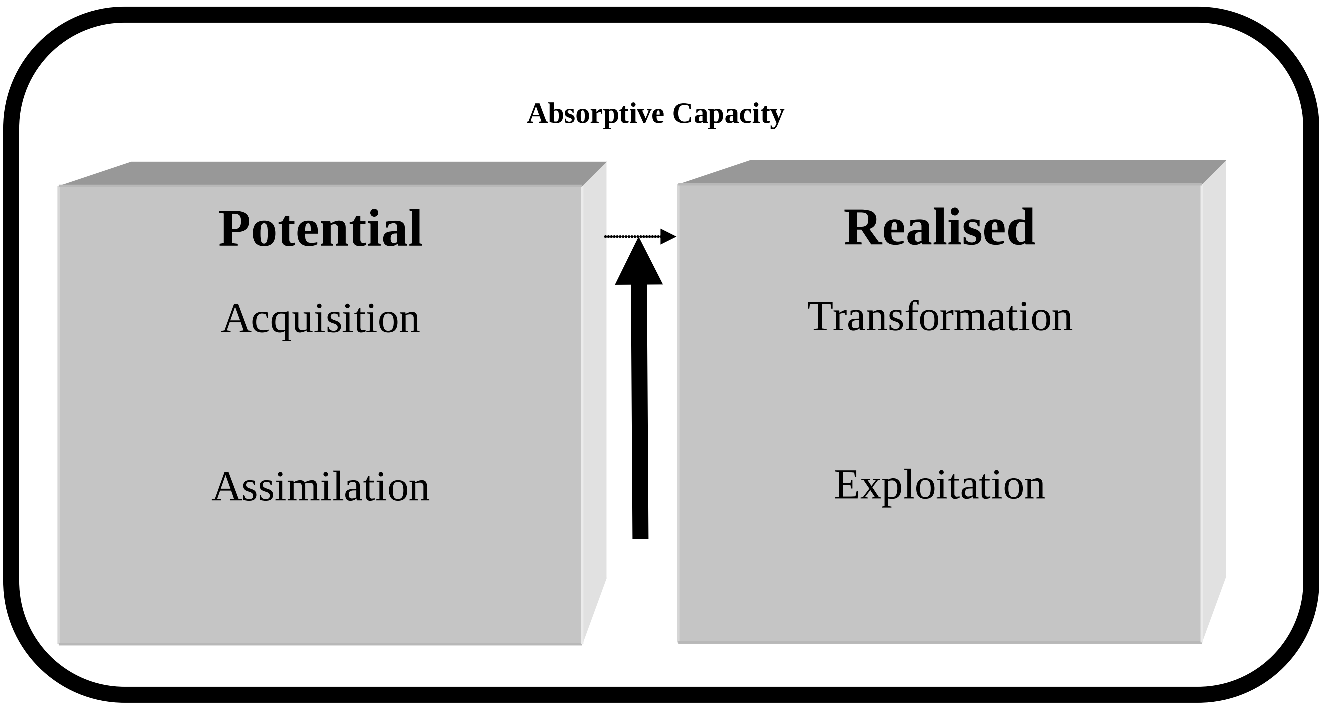

Figure 3.3 Components of Absorptive Capacity (Source: Zahra and George, 2002).

Acquisition, according to Zahra and George (2002), refers to a firm's capability to identify and acquire externally generated knowledge that is critical to its operations (see Figure 3.3). The intensity and speed of a firm's efforts to identify and gather information can determine the quality of firm's acquisition capabilities (Kim, 1997). Rocha (1997) stated that the direction of accumulating knowledge can also influence the paths that the firm follows in obtaining external knowledge. These activities vary in their richness and complexity, highlighting the need to have varying areas of expertise within a firm to successfully import external technologies. Daghfous

(2004), following research into the benefits of learning activities in the development stages of 120 university-industry technology transfer projects, added that acquisition depends on the following factors: prior investment such as R&D, prior knowledge, intensity in terms of the capability to develop new connections, speed of a firm's efforts to acquire external knowledge and strategic direction.

While acquisition refers to a firm's ability to identify and gather relevant knowledge, assimilation, according to Daghfous (2004), refers to the firm's ability to absorb this external knowledge and to understand, analyse and interpret it (Figure 3.3). A firm that cannot source and interpret external information will not be able to easily absorb the knowledge it needs (Cyert and March, 1963; Rosenkopf and Nerker, 2001). This externally acquired knowledge can sometimes embody information that differs significantly from that used by the organisation which can delay the ability of individuals in the organisation to understand and comprehend the knowledge (Leonard-Barton, 1995). External knowledge is also context specific which often prevents outsiders from understanding or replicating this knowledge (Szulanski, 1996). Zahra and George (2002) also stated that assimilation can be measured by the number of times a firm's publications cite research by other firms.

Figure 3.3 also illustrates transformation as a key component to the absorptive capacity of an organisation. The development of routines that facilitate combining existing knowledge with newly acquired and assimilated knowledge are all part of the transformation process. Zahra and George (2002) believed that this can be achieved by adding or deleting knowledge or simply by interpreting the same knowledge in a different way. Its two components are internalisation and conversion. Therefore, an organisation's ability to recognise two apparently incompatible sets of information and then combine them to arrive at a new understanding represents a transformation capability (Cohen and Levinthal, 1990; Zahra and George, 2002).

The application of knowledge and exploitation (the fourth component of absorptive capacity) is based on the routines that allow firms to refine, extend and leverage existing competencies (Cohen and Levinthal, 1990). Furthermore absorptive capacity allows the creation of new competencies through incorporating acquired and transformed knowledge into its operations (Zahra and George, 2002). Organisations may be able to exploit knowledge serendipitously;

however the presence of such routines provides procedural mechanisms that allow firms to sustain the exploitation of knowledge over an extended period of time. Exploitation reflects a firm's ability to harvest and incorporate knowledge into its daily business routine (Tiemessen, Lane, Crossan and Inkpen, 1997). Daghfous (2004) stated that exploitation of knowledge can be measured by the number of patents produced by a firm or the announcement of new products generated.

3.3.6 Factors influencing the absorptive capacity of individuals

Rothwell and Dodgson (1991) described the extensive collaboration of innovative SMEs and emphasised how the employment of key personnel affect the range and scope of linkages. They found that SMEs require well educated employees, i.e. leaders, to access knowledge from external resources. When examining the factors that can influence the increase in absorptive capacity levels within an organisation, education was viewed as a significant influencing factor. Cohen and Levinthal (1990) indicated that the facilitation of absorptive capacity is increased through an individual's possession of an academic degree. Cohen and Levinthal were of the opinion that an academic degree facilitated the use of new knowledge and increased an organisation's absorptive capacity. The link between the increase in absorptive capacity and an individual's education was commented on by Schmidt (2005) where he indicated that the more education and training an employee has the higher their individual capacity to assimilate decode and use new knowledge. As a firm's absorptive capacity depends on its employees, the general level of education, experience and training of their employees can have a positive effect on the firm's level of absorptive capacity (Schmidt, 2005). This concurs with previous research by Venkataramen (1997) and Shane (2000) which emphasised that individuals with academic degrees were more likely to embrace technology transfer activity and had the ability to recognise and act upon innovative ideas.

Similarly, organisational structure can influence the second factor of absorptive capacity, dissemination, which involves the transferring of acquired knowledge to all parts of the organisation involved in product innovation (Daghfous, 2004). The firm's structure should maximize the movement of knowledge through formal and informal networks (Welsch, Liao and

Stoica, 2001). Gradwell (2003) added that the strong influence of close networks and relationships within firms in stimulating the transfer of tacit knowledge has an effect on the absorptive capacity of an organisation. In addition Daghfous (2004) stated that organisational culture can have a positive influence on the level of absorptive capacity as it can provide incentives for knowledge diffusion through the empowerment of employees and managers.

As mentioned previously technology transfer needs individuals to transfer knowledge in order to be successful (Garud and Nayyar, 1994). Goh identified key activities essential to successful knowledge transfer within an organisation and it is deduced from analysing the literature that certain individuals are required for this success. Therefore, it would suggest that an organisation requires certain individuals to aid the effective transfer of knowledge through their leadership, trust building, collaboration, provision of support structures and absorptive capacities. Gatekeepers, when analysed from an organisation perspective (Allen, 1977) possessed similar qualities to these individuals identified as key to effective knowledge transfer in organisations. Section 3.4 of this chapter examines the role of gatekeepers in the knowledge transfer process.

3.4 Gatekeeper's role in effective knowledge transfer

Gatekeepers and their impact on the innovation process has been widely discussed in literature however, their influence on technology transfer in HEIs has received limited attention. From analysing the literature on effective knowledge transfer within an organisation and the literature on organisational gatekeepers it became apparent that the capacities of individuals located in organisations that are needed for effective knowledge transfer were similar to the capacities associated with organisational gatekeepers (Allen, 1977). Allen (1977), in research into the identification of technological gatekeepers and their informal role in an organisation, recognised that effective gatekeepers possessed certain capacities that were inherent to their behaviour within and outside an organisation. Mitchell (2009), in her research into licensing and incubators in American universities and their impact on the economy, stated that individuals that have an impact on the technology transfer process shaped the research and innovation culture of a HEI. Mitchell described these individuals as being members of the academic community who taught postgraduate students, led research centres, chaired departments and enforced policies and strategies related to technology transfer.

Trust is a significant advantage associated with gatekeepers as they can facilitate trust building among fellow employees and engage them in technology transfer activity. However, in some instances a recipient's lack of motivation or absorptive capacity can result in the poor transfer of knowledge from gatekeeper to employee (Goh, 2002). According to Allen (1977), following research on the influence of gatekeepers in industry, found that there is a tendency for certain people to become more acquainted with information sources outside their immediate community as they read more extensively than most individuals or develop network contacts with individuals/organisations outside of their own organisation. Due to the capacities that gatekeepers can possess, it is not uncommon for individuals within their organisation to become attracted to them and turn to gatekeepers for advice and information. The most significant capacity that gatekeepers possess is the ability to gather, decode and disseminate relevant knowledge which allows people to benefit from their own external relations but also linking other individuals in an organisation with external collaborative partners (Rychen and Zimmerman, 2006).

Giuliani and Bell (2005) and Boschma and ter Wal (2007) also recognised knowledge gatekeepers as actors characterised by high values of absorptive capacity and strongly connected with external knowledge sources. Harada (2003) discussed that the effectiveness of the role of the gatekeeper in R&D organisations was directly linked to the amount of time that the gatekeeper had spent in an organisation. This correlates with March and Simon (1958) and Zenger and Lawrence (1989) who identified tenure of academic faculty as a contributing factor to the degree of trust that other members of the academic community would have in an individual. Daghfous (2004) stated that gatekeepers were important to absorptive capacity as they were specialised actors present both within the organisation where they serve as boundary spanners between the firm's sub-units, as well as outside the organisation where they interface with its external knowledge environment (Cohen and Levinthal, 1990). According to Daghfous (2004) the main role that a gatekeeper plays is reducing the communication gap and mismatch between the producers and users of knowledge. However, Cohen and Levinthal (1990) noted that the individual absorptive capacity of a particular gatekeeper does not constitute the absorptive capacity of the organisation. Therefore, successful internal communication requires both the absorptive capacity of the gatekeeper and the ability of the individuals within the organisation to absorb the information made available by gatekeepers.

Vinding (2000), in research into the cumulative experience of workers and managers and their effect on absorptive capacity, argued that reducing the communication gap meant creating a common language and links between R&D and other departments. Moreover, the absorptive capacity of a firm's main gatekeeper enhances the process of organisational learning, which as Allen (1977) indicated, can assist in the comprehension of knowledge and its transfer and translation to other members within the organisation. In this context the presence of gatekeepers can play an important role in determining the rate and effectiveness of absorptive capacity. Vinding (2000) discussed that gatekeepers, whose role is to create a language that can be understood by different departments, can improve a firm's absorptive capacity through knowledge sharing. Gradwell (2003) stressed that gatekeepers' intermediary roles involve screening the environment for knowledge and transforming the relevant knowledge so that it can be understood by employees. Gatekeepers screen the environment for knowledge through certain channels such as research publications and most importantly through networks that they possess. The various channels of knowledge transfer are discussed in Section 3.5 particularly their utilisation by gatekeepers from an organisational setting.

3.5 Channels of knowledge transfer: Publication of research

Figure 3.2 illustrates that an organisational culture that promotes leadership, trust, collaboration with external parties, facilitation of organisational support structures for employees and also the capacity to absorb relevant knowledge and disseminate it to members of the organisation will be effective in knowledge transfer. Figure 3.2 also illustrates that an organisation that possesses a design that encourages networking, social networking and attendance at conferences amongst its employees will have an effect on the transfer of knowledge. Allen (1977), Bongers, den Hertog and Vandeberg (2003) and Brennenraedts, Bekkers and Verspagan (2006) referred to gatekeepers use of these channels (networking and attendance at conferences) to gather and transfer knowledge. Publication of research is one of the most typical and widely used methods of knowledge transfer as the research becomes public knowledge and therefore accessible to the outside world. However, Nonaka (1998) explained that only explicit knowledge is accessible to individuals. This is a disadvantage to companies who want to use this knowledge as they have to hire expertise to translate the research publication from tacit to explicit knowledge.

Individuals located in organisations (i.e. gatekeepers) who have the ability to gather, absorb and disseminate knowledge in the organisation to its employees can resolve this problem as they can translate the research into information to be disseminated throughout the organisation. Some authors argue that firms consider codified output, such as publications and patents, the most important form of accessible knowledge that is being developed by the university. For instance, Narin, Hamilton and Olivastro (1997) found that 73% of the papers cited in US industry patents were published by researchers working for public research organisations, while the remaining were authored by industrial scientists. Moreover, based on data from the Carnegie Mellon Survey on industrial R&D in the US manufacturing sector, Cohen, Nelson and Walsh (2002) found that the most important channels for universities to have an impact on industrial R&D were published papers and reports. Harada (2003) indicated that gatekeepers were the link for organisations in gathering these published papers and resources from external contacts and confer with and disseminate the relevant knowledge to other employees in the organisation. Brennenraedts *et al.* (2006) added that gatekeepers are helpful to organisations that want to use this explicit information from research publications as they can decode it into useable knowledge.

3.6 Networks

Networking is an important aspect of knowledge transfer and also impacts on technology transfer. As was stated by Allen (1977) gatekeepers screen the environment for knowledge through the network contacts that they possess. Bongers *et al.* (2003) indicated that individuals use the ability to speak at conferences and publishing their research to screen their environment for new knowledge and network contacts. Individuals then use the knowledge from their network contacts to enhance the quality of their work, but most importantly to expand the network contacts that they possess. Many of the contacts established between individuals in universities and industry occur as a result of the networks that are created. Gatekeepers within organisations are critical to the success of the knowledge transfer process as the networks they possess both internal and external to the organisation can increase the performance of their work (Tushman and Katz, 1980; Katz and Tushman, 1982). However, a clear and commonly accepted definition of networks does not exist (Waldstrom and Bollingtoft, 2008). Therefore, reaching an agreement on a definition is a recurring problem across a number of research fields, since many researchers cannot agree on what constitutes a network. Networks have been defined as links between individuals, groups or organisations (Seufert, vonKrogh and Bach, 1999). Brass, Galaskiewicz, Greve and Tsai (2004), in the investigation of cross level network phenomena, agreed with Cohen and Prusak regarding the linkages between individuals and stated that a network represents the existence or non-existence of links between individuals and organisations.

Oliver and Liebeskind (1998), whilst researching the use of networking to source intellectual capital in 554 new biotechnology firms during a 15-year period, stated that technology transfer, in the form of intellectual capital, takes place because of the interaction of scientists, technology transfer personnel and managers all within the organisation. The interaction amongst these people whether it is face-to-face or virtual over time creates communities of practice that amplifies and develops new information through the sharing of knowledge (Nonaka, 1994). Santoro and Gopalakrishnan (2001), following the study of 89 firms collaborating with 21 university research centres in the US, found that organisational structure, trust and an organisation's culture are all significantly associated with an organisation's knowledge transfer activities. The authors further concluded that collaboration can be increased significantly by increasing trust between industry and universities and can be achieved through the development of strong social ties facilitated by networking.

Blau (1977) commented, in his study on the effect of violent crime on the inequality and heterogeneity within the 125 American metropolitan areas, that the fundamental fact of social life is precisely that it is social—in so much that individuals do not live in isolation but associate with other individuals. In other words people influence the way in which networks affect an organisation and these networks are a factor in the channelling of knowledge within an institution and the subsequent transfer of technology. In order to channel this knowledge to other individuals in the organisation more often than not individuals will turn to network contacts for help and guidance (Blau, 1977) to stimulate organisational creativity.

From a higher education perspective, Lawton Smith, Glasson and Chadwick (2005) stated that knowledge required by firms to innovate is normally tacit and to translate and transfer that knowledge, personal network contacts between university and industry need to be effective. Pavitt (1998) in research into the transfer of information from university to industry stated that: *"there are various elements of problem solving capacity, involving the transmission of tacit knowledge through personal mobility and face-to-face contacts"* (p.797). In other words, problems can be solved through the use of networks to decode, translate and transmit knowledge effectively within the organisation (Goh, 2002). According to Huxham (1996) the formation of networks enables collaboration and is often a good way of achieving objectives that may be difficult or impossible to achieve by people individually. Huxham added that individuals are often motivated to join a network out of pure self-interest such as making a profit, making new contacts and/or to overcome changes that are affecting the organisation at that time.

From an organisational perspective, networks enable a firm to transfer and translate knowledge and gain access to valuable knowledge through social ties with other firms (Walter, Lechner and Kellermanns, 2007). Seufert, Von Krogh and Bach (1999), following research into the development of a framework for knowledge networking, inferred that networks have a specific set of linkages among a defined set of actors, with the additional property that the characteristics of these linkages as a whole might be used to interpret the social behaviour of the actors. The authors continued by stating that knowledge networking signifies the number of people, resources and relationships among them, who are assembled in order to accumulate and use knowledge primarily by means of knowledge creation and transfer processes, for the purpose of creating value.

Networks have many advantages, qualities and strengths which are embedded within particular locations linking expert people in different locations who have a particular set of skills. Tracey and Clark (2003) described networks as political systems that contain many competing and overlapping rationalities resulting in academics believing they need to network with industry personnel. This need may be misguided as individuals may already be engaged in extensive networks and the demand to develop new ones may compete with personal professional objectives. Critical informal networks often compete with and are fragmented by aspects of organisations such as formal structure, work processes, geographic dispersion, human resource practices, leadership style and culture (Cross, Borgatti and Parker, 2002). The authors continued by stating that individuals rely heavily on their network of relationships to find information and solve problems. However, Klingner and Vaughn (1996) indicated that it may be difficult to solve problems as it could be complicated to find people of different expertise, be it academic or practical experience, backgrounds and problem solving styles to effectively integrate their unique perspectives in their networks.

A network benefits firms by enabling them to access information from diverse sources to which a firm is connected only indirectly. Indirect sources of knowledge would be inaccessible without the knowledge transfer network (Kota and Prescott, 2002). According to Schonstrom (2005) knowledge networks have a positive effect on knowledge transfer and knowledge creation. This knowledge creation is supported by the networks of different individuals and communities and the knowledge that they disseminate (Danneels, 2002; Dyer and Nobeoka, 2000; Eisenhardt and Martin, 2000). Eisenhardt and Martin (2000), in their research on the dynamic capabilities of individuals in an organisation, were of the opinion that to use individuals that have different perspectives and experiences is effective in knowledge creation because it can enhance the range of information available. Evidence from Swan, Newell, Scarbrough and Hislop (1999) from research into the limitations of using IT to create a network structure and encourage knowledge sharing, found that networking supports innovation because individuals become aware of new technologies and new knowledge by boundary spanning activities like networking. Through these activities individuals increase access to knowledge that may be of relevance to their own organisations.

This linking of knowledge between individuals throughout the organisation has been described as social networking. According to Thompson (2003) the way individuals interact with each other can be examined through their network contacts. This is what Thompson termed social network analysis where the relationships between individuals and their contacts can be evaluated.

3.6.1 Social Networks

A well-known source of channelling knowledge is the flow of information via social networks. Social networks have been defined as a mapping and investigation of the relations among a group of actors. The relations can represent for example, friendship, liking, communication, workflow or the exchange of goods among actors representing individuals, organisations or even nations (Scott, 2000). Social networks can be in the form of alumni societies, from a higher education perspective. These networks tend to have a strong influence in the relationship between industry and academia as many of the individuals in the alumni would be working in industry and sharing their links with the academic community.

One of the central components of a firm is the existence of differential power relations within a people network that shape the processes and practices of the firm. Powerful actors are the ones that drive the network and make things happen. Bridge (2002) stated that the power within a network is a function of the position of an individual within the network or is derived from the strength of association between the actors that comprise the network. Cross and Parker (2004), in research into the hidden power of social networks in an organisation, identified four kinds of individuals who can comprise a network based on their association with and interaction with other individuals in the organisation.

The first type of person is the central connector. Central connectors affect the organisational network as a whole and engage in problem solving and responding to information requests. According to Cross and Prusak (2002), in writings about the individuals in an organisation that link people together, these people are not usually the formal leaders within the department, but they do know who can provide critical information or expertise that the entire organisation can refer to, to access vital knowledge. However, individuals can be so central that they restrict the organisational network as they hold all the information and if it is not communicated the firm cannot progress. Freeman (1979) noted three related measures of centrality which were the number of contacts, betweenness and proximity. The number of contacts referred to the degree of activity of the person within the network while the betweenness described the extent to which one person has control over another person within the network. Proximity was also discussed by Boje and Whetten (1981) and Blau and Alba (1982) and describes the extent to which a person within a network can avoid the control of others. Brass (1985), in an investigation into the interaction patterns of men and women in an organisation and the relationship of the patterns, also discussed the proximity issue with regard to male and female networks and identified that individuals also tend to form informal relationships with people who they are working in close proximity.

The second type of person Cross and Parker (2004) identified are the boundary spanners. Cohen and Levinthal (1990) stated that the boundary spanner was the most important individual in a network. Boundary spanners provide critical links between groups that can be defined by physical location or hierarchical level. Boundary spanners nurture connections mainly with people outside of the formal network for example, through communicating with people in other departments within the company and even outside the organisation (Cross and Parker, 2002). Boundary spanners play an important role in situations where people need to share different kinds of expertise, for instance, through the establishment of strategic alliances or developing new products. According to Cross and Parker few networks have boundary spanners as many people do not have the breadth of expertise, wealth of social contacts and the personality traits necessary to be accepted by different groups.

The third type of person Cross and Parker (2004) identified were peripheral people. Peripheral people or experts are known as the outsiders of the network. These people serve as experts who possess specific kinds of information or technical knowledge that they pass on to members of the group when needed (Cross and Parker, 2002). The skills, expertise and unique perspectives of network outliers are often not leveraged effectively and therefore represent underutilised resources.

The final type of person Cross and Parker (2004) identified were information brokers or gatekeepers. Gatekeepers as mentioned previously, provide functions of meaning translation, trust building and tacit-explicit conversions (Rees, 2007). Information brokers (gatekeepers) disseminate information throughout the organisation and promote connectivity amongst the individuals within the organisation and also with individuals outside of the organisation. According to Cross and Parker (2002) information brokers are disproportionately important to the informal network's effectiveness because they wield the power of a central connector without necessarily possessing the direct links that connectors have**.** Leadership skills, communication skills and most importantly the capacity to develop a strong community from extended networks (Rice and Matthews, 1995) are the most important and effective traits that the gatekeeper possesses to aid the successful transfer of technology and knowledge within and outside the organisation network. According to Nonaka (1998) the importance and power of the gatekeeper on the technology transfer process is built on the context that knowledge needs to be decoded in order to be understood by organisations. Tushman and Katz (1980) stated that the gatekeeper is the person that acts as an intermediator of contacts and knowledge. However, Petruzzelli, Albino, Carbonara and Rotolo (2010) argue much more research needs to be undertaken into the nature of the relationships and knowledge flows exchanged by gatekeepers. In fact, most of the discussion about this type of actor has been in the context of their function and not of their network relationships.

3.6.2 Gatekeepers and Social Networks

It has been established above that gatekeepers are essential in the transferring of knowledge and they achieve this through utilising their network contacts. Gatekeepers are able to gather and understand external information and subsequently translate the information into terms that are meaningful and useful to more locally orientated colleagues (Tushman and Katz, 1980). Rychen and Zimmermann (2006) agreed with Tushman and Katz (1980) and stated that the most significant asset gatekeepers have is the ability to contribute to the articulation of internal and external resources (networks), allowing other individuals in an organisation to benefit from their own external relations but also extending local resources to peripheral actors.

Studies on knowledge gatekeepers have developed in the area of network theory and explain the role of specific individuals belonging to networks, characterised by their capability to collect, combine, and diffuse knowledge (Hargadorn, 1998). Tushman and Katz (1980) following research into the role of gatekeepers in the transfer of information within an R&D facility in a large American corporation employing 735 people, viewed gatekeepers as communicators to members of an organisation who also maintained a high degree of extra-organisational communication. The authors studied the impact of gatekeepers on both internal and external tasks. They were of the belief that one way to deal with the difficulties of communicating across differentiated boundaries was through gatekeepers. With the help of these key individuals, external information can flow into the system by means of a two-step process. First, gatekeepers are able to gather and understand external information, and subsequently they are able to translate this information into terms that are meaningful and useful to their organisational colleagues.

Whitley and Frost (1973) and Balbridge and Burnham (1975) stated that gatekeepers were primary linking mechanisms to external sources of information. They stated that information flowed through these gatekeepers to the more local members of the network. In other words information exists and is disseminated to other members in the organisation due to the boundary spanning networking activities of the gatekeeper. In summary, it can be seen that gatekeepers translate information, i.e. refereed journals, for those in the organisation who cannot interact with external sources of knowledge (Morrison, 2004), by utlising their social networks. Through these networks, gatekeepers identify external sources of information, interpret, absorb the information and translate the pieces of knowledge into meaningful language for their colleagues (Tushman and Katz, 1980). In order to accomplish such tasks gatekeepers require a degree of absorptive capacity above the mean. In addition they have to develop a strong social capital, which requires them to be connected to several sources through a social network. Therefore, it is apparent that gatekeepers are an important asset in the translation and dissemination of knowledge in an organisation which can lead to the eventual transfer of technology. However, the effectiveness of the social network capability of the gatekeeper can become strained as there are many obstacles to the transfer of knowledge such as individual's characteristics and the degree of trust that exists between employees of organisations and the gatekeeper.

3.7 Factors that impact on the effectiveness of knowledge transfer in the technology transfer process

This section outlines the main factors that impact on the effectiveness of knowledge transfer on technology transfer which are: the gatekeepers' role in the HEI, the way in which knowledge can be transferred, the perception of HEIs and their cultural differences and the lack of trust between individuals. Taking the first factor into account Bongers *et al.* (2003) viewed gatekeepers as being a very important asset in the transfer of knowledge within an organisation. From a higher education institute aspect, Bongers *et al.* (2003) considered gatekeepers to be a significant influence on informal relationships in the successful transfer of knowledge from universities to the outside world. Their role and characteristics can influence knowledge that is transferred between universities and industries (Brennenraedts *et al.*, 2003) while their reputation can have an effect on the way that they react and affect the transfer of knowledge. Researchers/academics that hold a senior position in a university will probably hold more credibility and more knowledge than that of a PhD student, thereby having more contacts and a bigger social network which industry can tap into (Brennenraedts *et al.,* 2003). Based on research by Johansson, Jacob and Hellstrom (2005) into the relationship between Danish universities and academic spin-offs and the strength of strong ties between the two organisations, it was found that the relationship between industry and universities consists of a small number of strong ties with a high degree of trust. The characteristics of trust and social networking relate to the qualities that a gatekeeper can possess however, the majority of literature is written from an industry perspective and not from a higher education institution perspective.

The way in which knowledge is transferred can also affect the transfer of technology. Knowledge is increasingly recognised as a vital organisational resource that provides market leverage and competitive advantage (Leonard-Barton, 1995). Polanyi (1967) was of the opinion that humans know more than they can actually communicate which implies that unless humans possess the appropriate channels to transfer knowledge, knowledge could be lost in translation. If knowledge is not being transferred to others within the organisation then overall productivity of the organisation will be reduced as those who need the information will not receive it. Consequently, if gatekeepers cannot source the relevant information it will not be translated and disseminated to others in an organisation.

Furthermore, the perception of higher education institutes can also be viewed as an obstacle to knowledge transfer. Based on research by Etzkowitz, Webster, Gebhardt and Terra (2000) into the role of the university in knowledge based society it was concluded that industry perceived the higher education sector as difficult to collaborate with and defined this issue as the Ivory Tower Syndrome. The ivory tower can contribute to the lack of information and poor communication about the function of higher education institutions and the sharing of state of the art science and know how (Schartinger *et al.*, 2001). Consequently, universities were viewed by industry as inaccessible and unwilling to share knowledge with Schartinger *et al.* (2001) emphasising that higher education institutes follow their own individual rationality in deciding whether to establish relationships with industry. Dooley and Kirk (2007) added that due to the differing cultures of higher education and industry, the two sectors operate on different timescales, have different objectives to fulfil and often have different value systems (Elmuti, Abebe and Nicolosi, 2005).

Previous research by Jones-Evans, Klofsten, Andersson and Pandya (1999) concluded that higher education institutes liked to publish their knowledge and industry prefer to remain secretive. In contrast, Etzkowitz, Webster, Gebhardt and Terra (2000) were of the opinion that higher education institutes were seen as a place of teaching and learning and did not like to share their knowledge with the outside world especially firms who like to publicise results. However, Etzkowitz *et al.* (2000) proposed that the 'ivory tower' syndrome that had existed in many higher education institutions had been replaced by a renewed interest in technology transfer. Although Connect Yorkshire (2004) proposed that industry and academia should be natural partners, they also recognised that differences existed in the culture, terminology, objectives and expectations of both industry and HEIs. Also the skills required to manage an academic R&D project are vastly different to those required to manage the commercial, financial, human and administrative issues of the technology transfer process.

Lack of trust between individuals can also act as an obstacle to the successful transfer of knowledge. However, this is where gatekeepers can be effective as they work on building trust between employees within the organisation and focus on bringing them together to share knowledge (Rees, 2007). However, it is interesting to note that the influence and role of gatekeepers in a higher education setting has not received much attention in literature to date. From an organisational perspective, strong ties or friendships can overcome the obstacle of trust within a knowledge transfer setting (Santoro and Gopalakrishnan, 2001) and different friendships affect knowledge transfer in different ways. With the emergence of a more knowledge intensive economy, scholars have become interested in knowledge creation and transfer within organisations (Brown and Duguid, 1991; Kogut and Zander, 1992; Nonaka and Takeuchi, 1995; Spencer, 1996). In particular, research has consistently illustrated that relationships have a strong effect on the success of knowledge transfer (Hansen, 1999; Szulanski, 1996; Uzzi, 1997). One of the most important aspects of a relationship in this context is trust (Tsai and Ghoshal, 1998). Interpersonal trust is important to many organisations and is critical to knowledge transfer as it enables people to share information more effectively (Burt, Crammer, Rousseau and Sitkin, 1998). Trust plays an important part in these interpersonal relationships with regard to the characteristics of relationships within an organisation, such as who is tied to a social network (Burt, 1992; Baker, 2003).

From the literature review it can be seen that there are impeding factors on the successful transfer of technology. From an industry perspective gatekeepers minimise the poor communication and knowledge dissemination barriers that can occur in the technology transfer process. Another important factor in the successful transfer of technology from a national and HEI perspective are the policies that are implemented by key government funding agencies. The next section of the literature review investigates the policies relating to technology transfer in HEIs and also the government policies relating to research and enterprise and their effect on technology transfer.

3.8 The impact of policy on technology transfer

The aim of this section is to review literature on government policies and technology transfer. Based on research by Etzkowitz and Leydesdorff (2000) into the increase in entrepreneurial activity in Massachusetts Institute of Technology (MIT), it was found that the success of technology transfer processes can be limited and rely on the effective relationship between government agencies, industry and higher education institutes. The policies that are implemented by governments can impact on the effectiveness of the relationship between the government, industry and higher education particularly the link and relationship between higher education institutes and industry as they will always clash due to two quite different organisational cultures (European Commission, 2005).

Smith (2001), following research into knowledge creation in UK universities, concluded that the distribution of public research funding to institutions takes place in a rapidly changing policy landscape where demand exists for research that benefits local and regional communities, expectations that research is relevant to the needs of industry and can be used to develop new products and services. Smith further stated the creation of new knowledge is no longer a closed intellectual endeavour confined to the world of higher education institutions but rather a world where government policy makers are seeking a return on the investment made in research and innovation.

Since the start of the 21st century, governments and their agencies in Europe have developed new expectations of publicly funded research where research is expected to make explicit economic contributions, through technology transfer process outcomes either in the form of products and services or through improvements in the quality of life (Veltri, Grablowitz and Multatero, 2009). According to Veltri *et al*. (2009) all EU Member States are becoming increasingly aware that enhancing their economic performance and responding to societal needs will require research and development (R&D) policy to be more clearly articulated by government agencies. Yusof (2007) stated that national governments both in Europe and America have begun increasing the number of policies to promote research in universities and encouraging higher education-industry links. Yusof further stated the push towards research and its commercialisation (technology transfer) has increased because governments are trimming their contributions to higher education budgets and requiring them to supplement the income they receive from government agencies by commercialising the research that they produce.

According to Storey (1998), many national governments particularly in Europe view the United States as the leader in the development of technology transfer policy. America has been the leader in technology transfer activities for the past three decades since the introduction of the Bayh-Dole Act (1980). The US government believed that the commercialisation of government funded research was disadvantaged by the government ownership of the intellectual property rights and that state-owned patents were insufficiently utilised (Eisenberg, 1996; Berman, 2008). In order to provide American society with the benefits of university research in an efficient, effective, and socially optimal manner, the US congress designed an act to allow federal contractors including universities to claim title to inventions made as a result of federally funded research. The Bayh-Dole Act (1980) allowed US universities to patent inventions funded by federal money and to retain the royalties that these patents generated (Coupe, 2003). It is because the Bayh-Doyle Act provided U.S. universities with the right to commercialise employees' inventions made while engaged in government-funded research that the rest of world now view the US as the best practice indicator of successful technology transfer policy implication (Kenny and Patton, 2009).

The effectiveness of this technology transfer policy adopted by the American government can be seen in institutions like Stanford University, where Fisher (1998) found that the creation of wealth, new jobs and new solutions to problems in society could be attributed to technology transfer policies. Stanford's success as a leader in technology transfer, its contribution to

California's Silicon Valley and the biotechnology industry provided a model of best practice in technology transfer for other universities not just in America but in Europe as well. However, Carlsson and Fridh (2002) clarified that Stanford's success in generating technology transfer had occurred in spite of the policy that existed within the university to discourage the promotion of technology transfer. Therefore, the authors concluded that success in technology transfer depends not only on the policies implemented by government but also on the entrepreneurial climate in the academic community. Research by Bremer (1999) found that the real measurement of successful technology transfer was not in the number of patents and licenses which the academic institution possesses, it was actually in the amount of technology represented in those patents that have been transferred to the industrial sector for further development into products that can be useful to society.

Another government whose policies focus on the relationship between higher education and industry is the Swiss government's policy on research, development and innovation. The policy focuses strongly on promoting the cooperation and network building between industries and higher education institutions (Foray, 2007). Switzerland has no tradition of direct policy interventions however; the country's main policy mechanism deals with promoting technology transfer and research cooperation between higher education institutes and industry. The Commission for Technology and Innovation's main role is to finance R&D for the business sector at Swiss public research institutions. Since the introduction of this particular policy the innovation performance of industry has increased (Arvanitis, Hollenstein and Marmet, 2006). Foray (2007) found that the Swiss government's bottom up approach to strengthening technology transfer between academia and industry, its coaching service for start-ups and its nationwide education programme for would-be entrepreneurs were mainly responsible for the increase in industry performance.

Since the introduction of the Science and Innovation Investment Framework (2004) in the United Kingdom, there have been some important policy related introductions (Hughes, 2007). The first important policy introduction was in relation to higher education spending, the investment framework for science and innovation makes a basic commitment to the full economic costing of higher education research projects. Secondly, the Technology Strategy Board was introduced as a key intermediary role between science and technology projects with market potential and the industry sector (Hughes, 2007). Hughes added that the purpose of the Technology Strategy Board was to promote activities in the higher education sector of direct and indirect economic benefit to the UK.

From an Irish perspective, government policy relating to technology transfer, research and innovation has resulted in high levels of fragmentation, low levels of collaboration and lack of critical mass (Cunningham and Harvey, 2004). The Irish government addressed this issue with the publication of the policy for Science, Technology and Innovation (2006) which aimed to address Ireland's approach to research (Department for Enterprise Trade and Employment, 2006). One of the most important aims of the strategy was to bring government and higher education institutes together so that there was coherence and a common level of understanding, themes and professionalism for collaboration to occur. In order to increase collaboration with industry and to portray the higher education sector as being professional collaborators, the Irish government allocated approximately €3.46 billion in research and innovation funding to both the University and Institutes of Technology (IoTs) sectors since 2006 through Science Foundation Ireland (SFI), Higher Education Authority (HEA) and Enterprise Ireland. Irish national policy suggested that the research role of the Institutes of Technology (IoTs), in particular was set to take on increasing importance in coming years however there is no official government research policy that relates specifically to IoTs although there are references in the underpinning legislation and other documents that IoTs should focus on applied research with a regional focus (Lillis, 2007; Hazelkorn and Moynihan, 2010)

Evidence suggests that technology transfer policies adopted by national governments, which are applied by HEIs, can impact on society (Carlsson and Fridh, 2002). The biggest benefit to society from policies adopted by HEIs in technology transfer is that the results of the process can be transferred to the public. Most importantly, properly implemented technology transfer policies can provide a service to academic faculty and inventors in dealing with industry arrangements and technology transfer issues. Furthermore, government policies can encourage academic staff to develop new technologies and encourage the facilitation of industry collaboration. Properly implemented technology transfer policies can also act as a source of marketing expertise to attract students, faculty and external research funding to the institution to develop the technology transfer process (Carlsson and Fridh, 2002).

Fisher (1998) stated that there were many benefits to society of a well-functioning technology transfer process flowing from universities to the commercial sector. This point was clarified by research completed by AUTM (1998). The association's research commented on the benefits to society of properly implemented technology transfer policies in America and it was shown that nearly $25billion of economic activity in America could be attributed to the results of academic licensing, supporting 212,500 jobs (AUTM, 1998). Therefore, the ability of higher education institutions to incorporate government policies on technology transfer into their research strategies, according to Carlsson and Fridh (2002), could assist in the effective dissemination of technology research for public good. Furthermore, it may well be argued that technology transfer is even more important to the surrounding communities than to the higher education institutes themselves because of the benefits it creates to the rest of society. However, Bok (2003) disagreed that higher education institutes incorporating government policies into their research strategies was of any benefit to them or the community in the long term. Bok believed that this would have a negative effect on the institution and that *"to commercialise a higher education institution is to engage in practices widely regarded in the academy as suspect, if not downright disreputable"* (Bok, 2003, p.18).

It is important to acknowledge that Bok (2003), in his research into the growing commercialisation of academic institutions in America and what universities can do to limit the damage caused by undermining core academic values, did not consider technology transfer policies to be bad for institutions; in fact he believed that they could learn something from the world of commercialisation. He did, however, believe that higher education institutes that encompassed policies driven by their national governments into their research strategies on the development of technology transfer would act as a distraction to academic faculty. Ultimately Bok's research concluded that by following a commercialisation policy in higher education, it would act as a distraction to the real reason why the institutions existed which was to teach. Nicholls (2006) agreed with Bok, that government policies on technology transfer and commercialisation of research in particular could distract education facilities from their original mission as a teaching institute.

From an Irish perspective, the policies implemented by the Irish government regarding research, enterprise and technology transfer do not comply with the institute policies of the IoT sector and are more directed towards the university sector (Hazelkorn and Moynihan, 2010). Therefore, to implement national government policies on commercialising technology transfer research would not be possible for IoTs as their academics are contractually obliged to lecture 560 hours per year or 16 hours per week which is often re-interpreted by some academics and their trade unions as only doing 16 hours work per week (Hazelkorn and Moynihan, 2010). However, the working week consists of 37.5 hours and while academics only lecture 16 of those hours they also require time for preparation of lectures, correction of assignments and supervision of student thesis which can hamper the amount of research i.e.: technology transfer activity being undertaken in IoTs. Therefore, it would seem, from an IoT sector point of view, which government policies for technology transfer do not always match as the academics believe their time should be allocated to teaching and not research (Hazelkorn and Moynihan, 2010).

The Irish government funding agency, Enterprise Ireland (EI), set up the Technology Strengthening Initiative (TSI) programme to support and strengthen the technology transfer system in Ireland through a mechanism of funding individual higher education institutes to resource their Technology Transfer Offices and functions (Enterprise Ireland, 2009). Findings from the report of the TSI showed that higher education institutes in Ireland are measured on a number of targets and measures of technology transfer such as patents, licenses and research expenditure on personnel in the institute.

It would seem that this situation is not unique to Ireland as Smith (2001) found, from a UK perspective, that research councils routinely intervene in the development of new priorities for research in their respective disciplinary areas through their funding policies. Smith (2001) called this Directed Funding where, through a variety of procedures, funding is placed with those researchers most likely to address the relevant issues. It would seem that the institutes that have the resources and time to allocate to obtaining funding from government funding agencies will benefit from the policies on technology transfer that are implemented. Therefore, it seems that institutes, whose strategies are focused on teaching and not research, tend not to benefit as they do not have enough time or resources to commit themselves fully to submitting funding proposals to the government funding agencies.

Fassin (2000) stated HEIs are playing a more active role in the process of technological innovation by licensing inventions and discoveries to industry. However, Smith (2001) concluded that government policies that only rewarded institutes who demonstrated research and commercialisation excellence would gradually alienate the poorer performers of technology transfer. From an Irish perspective, the rhetoric of the knowledge economy (Bullen, Robb and Kenway, 2004; Bullen, Fahey and Kenway, 2006) has been the key defining feature of recent change and at the core of current government policy with regard to higher education, where institutes are encouraged to engage in technology transfer activities in order to receive funding from the government. In a review of Irish technology transfer research policy in 2009 it was found that in contrast to what was stated previously by Bullen, Fahey and Kenway (2006) that in fact collaboration was not strongly encouraged in the IoT sector and there existed no clear policy on transferring the technology out to the industrial sector. Therefore, technology transfer policy needs to be developed further so as not to leave the poorer commercialisation performers, particularly the IoT sector, out of funding opportunities for technology transfer.

3.9 Chapter Summary

The literature review chapter described the technology transfer process as being influenced by the transfer of knowledge (see Figure 3.2). Indeed it was stated by Garud and Nayyar (1994) that knowledge was needed in order for technology to be transferred. Furthermore, research by Goh (2002) illustrated that successful knowledge transfer in an organisation relied on an organisational culture of leadership, trust, support structures, collaboration and absorptive capacity. Bercovitz and Feldman (2003) believed that individuals within an organisation that had experience in technology transfer, would lead by example and be successful in engaging others in the technology transfer process. These individuals' experiences enabled them to engage the trust of other individuals in an organisation to encourage them to start transferring their technologies. In particular, individuals that were trusted by other members in an organisation had the ability to infiltrate the barrier of transferring technological know-how between academia and industry. The literature review also demonstrated that collaboration was an important facet in the dissemination of knowledge and relied on certain individuals within an organisation to encourage collaboration activities within the organisation such as team work amongst employees. If there is no collaboration between organisations such as higher education institutes and industry then technology transfer will not be successful.

From the review of the literature on the role of knowledge transfer in the technology transfer process it became apparent that individuals were important facets in the knowledge transfer process and also possessed capacities of gatekeepers as proposed by Allen (1977) and Mitchell (2009). The authors suggested that gatekeepers had the ability to lead research centres and were at the core of the information network corresponding with Goh's (2002) opinion that a successful knowledge transfer process required leadership and absorptive capacity. Allen (1977) also proposed that gatekeepers facilitated the collaborative process through the communication with external linkages and the dissemination of the knowledge received.

Allen (1977) and Mitchell (2009) stated that gatekeepers support the transfer of knowledge and also engage individuals in technology transfer activities. Gatekeepers are also essential to making sure that the knowledge that is in the organisation can be transferred and understood by other employees in order to support the sharing and accessing of essential knowledge. Therefore, it can be deduced that individuals are needed for the transfer of knowledge and can be referred to as gatekeepers. The literature review has shown that gatekeepers are an essential part of the dissemination of knowledge in an organisation setting. As stated by Daghfous (2004) the gatekeeper is the crucial element in reducing the communication mismatch and creating a common language that is understood by people in different departments. It was also found from the literature review that the education of individuals had an impact on their ability to gather and disseminate information (Shane, 2000).

In order to absorb, decode and transfer this information gatekeepers use certain channels to access the knowledge. Two of the most important channels were networks and social networks. Networks are a crucial channel for knowledge to be transferred. Oliver and Liebeskind (1998) stated that networking facilitated the transfer of technology in higher education institutes because of the interaction and trust between academics and technology transfer personnel. Networks are seen to enable the collaboration i.e. knowledge transfer between higher education institutes and industry, however in research by Klingner and Vaughn (1996) it was stated that sometimes it was difficult to obtain people with different expertise and engage them in networking. However, organisations that possess gatekeepers can be successful in getting diverse expertise to network with each other as they can link people together (Allen, 1977).

Social networking is also an essential source of channelling knowledge to others within an organisation. Bongers *et al*. (2003) argued that most of the personnel contacts that are made between academia and industry originate from social network activity. Gatekeepers are crucial in linking academia and industry together through utilising social networks. Social networks also have four different types of individuals that comprise and influence an organisations network (Cross and Parker, 2004). The networks can encompass central connectors to respond to information requests. Boundary spanners are the second type of person who provide the critical links between groups. They also nurture connections outside the organisation and can communicate with other people in departments within and outside the organisation. The third type of people were peripheral people who were outside of the network and possessed specific kinds of information that they can pass onto members of the networks when it is needed. Finally Cross and Parker (2004) made reference to information brokers who act as gatekeepers to an organisation and disseminate information to those that need it in the organisation. Therefore, it was concluded from the literature review that gatekeepers are in fact the knowledge transfer instrument in the technology transfer process and use certain resources such as networks to gather and absorb relevant information to disseminate to others within the organisation.

The final section of the literature review examined government policy in relation to technology transfer. The literature concluded that policies on research and innovation have become the main focus of both the UK, Swiss and Irish governments' in the last number of years. Properly implemented policies provide a source of support for academics engaging in technology transfer (Carlsson and Fridh, 2002). Policies that are enforced and implemented in the right way can encourage academic faculty to engage in the technology transfer to collaborate with industry partners.

Properly implemented policies within higher education institutions can have implications for the community, in that the more technology that is transferred the more jobs are created in society. In a study of Stanford University's technology transfer outputs by Fisher (1998) it was found that the university's success contributed to the creation of Silicon Valley and subsequently provided a model of best practice for other higher education institutes engaging in technology transfer. In contrast Bok (2003) was of the belief that technology transfer policies that were implemented in higher education institutes could have a negative effect on the institute itself. He viewed that policies forcing academic faculty to engage in technology transfer activities could distract them from their real purpose at the institute thereby creating tensions and distrust amongst faculty that did not previously exist. Smith (2001) believed that there were some problems with governments' focus on technology transfer. Firstly, government funding agencies require a return on their investment in the form of a commercial product from research conducted. Secondly, governments are placing funding with researchers who are most likely to address the relevant research issues and leaving those who do not meet the targets behind (Smith, 2001). Finally, government funding agencies implement the policy of only rewarding research excellence which, consequently does not provide for the poorer performing HEIs. Therefore, those institutes that are high performing will obtain the funding while those who are not as successful will be left behind (Smith, 2001).

From the investigation of the literature into the technology transfer process and the role of knowledge transfer on the process it has become apparent to the researcher that gatekeepers are essential to ensuring that knowledge is disseminated to those individuals involved in the technology transfer process. As Allen (1977) proposed, the industry sectors that are involved in technology transfer activities possess gatekeepers who are key to gathering, disseminating and translating of knowledge to others. Therefore, it is not unrealistic to expect that higher education institutes would also have gatekeepers whose primary function it is to disseminate knowledge throughout the institute and increase the academic faculty engagement in technology transfer.

In summary this literature review has demonstrated that successful technology transfer relies on the effective transfer of knowledge as technology transfer cannot be transferred from and within an organisation without the presence of a gatekeeper to decode and disseminate the necessary information. Researchers such as Nikulainen (2007) and Friedman and Silberman (2003) described the influence of academic faculty on the transfer of technology, however, evidence of the existence of individuals who can influence and engage academics in technology transfer does not seem to be as extensive, particularly from an IoT perspective. Previous models on technology transfer (Friedman and Silberman, 2003) depict the process within higher education institutes as flowing from idea generation to invention disclosures to wealth, it does not however, illustrate how the TTO encourages academics to share their ideas and engage in the technology transfer process.

The next chapter examines the methodology employed in this study. The chapter describes the philosophical assumptions underlying the study in addition to detailing the methods employed in investigating the research question to what extent do gatekeepers influence technology transfer in IoTs.

Chapter 4: Philosophical Considerations and Primary Research Approach

Chapter Four Philosophical Considerations and Primary Research Approach

4.1 Introduction

This chapter describes and justifies the philosophical and methodological foundation of this research and the methodology adopted. Research is constructed on the foundations and underlying assumptions as to what constitutes valid research in addition to determining the appropriate research methods. The philosophical stance guides the conceptualisation impact on the perspective and research approach in addition to the way in which the data is gathered and analysed.

The philosophical debate revolves around paradigms which have been described by Lincoln and Guba (1985) as a set of beliefs with Creswell (1994) adding that paradigms help us to understand social phenomena. Gummesson (1991) viewed paradigms as representing a world view of an individual's judgments, norms, standards, frames of reference, ideologies, myths and theories and most importantly their thinking and actions. Thyer (1993) defined research design as a blueprint for how a research study should be conducted. This includes selecting a suitable sample size to reflect the population being investigated and collecting the data to be used as a foundation for analysing the results. Metrics of technology transfer are utilised to select a suitable sample of IoTs for this research study. The reasoning for using such metrics is twofold. Firstly, patents, licenses, invention disclosures and start-up companies are all vital elements of the technology transfer process outlined by Spann, Adams and Souder (1995) and Friedman and Silberman (2003). Secondly, these elements are used as measurements of IoT performance for the allocation of funding for future research by government funding agencies such as Enterprise Ireland.

As this research is seeking to ascertain the influence that gatekeepers have on the technology transfer process a qualitative approach using interviews was deemed the most appropriate to discover the answer to the research question. The purpose of this study is to establish to what extent gatekeepers influence the technology transfer process which requires the researcher to describe the influence that gatekeepers have on the technology transfer process. Through the process of semi-structured interviews, the researcher was able to perform an in depth analysis of the possible relationships between gatekeepers' education, background experience and networks and their influence on technology transfer within and outside of the IoTs. The next section of this chapter illustrates the research process used in this study.

4.2 Overview of the Research Process

According to researchers such as Brannick and Roche (1997); Gill and Johnson (2002) and O'Leary (2007), through detailing a plan of activity, accommodating for the what, how and actually doing is required in order to meet the objectives of a research study. Figure 4.1 illustrates the structure of Chapter 4, i.e. the plan of activity, which starts with the research question and objectives. This study also pays close attention to the appropriate theoretical framework best suited to answer the research question. Furthermore, this chapter discusses the most appropriate research design and methods of data collection which will provide answers to the objectives of the research. Finally, the chapter discusses the ethical, validity and reliability issues regarding the research study being undertaken.

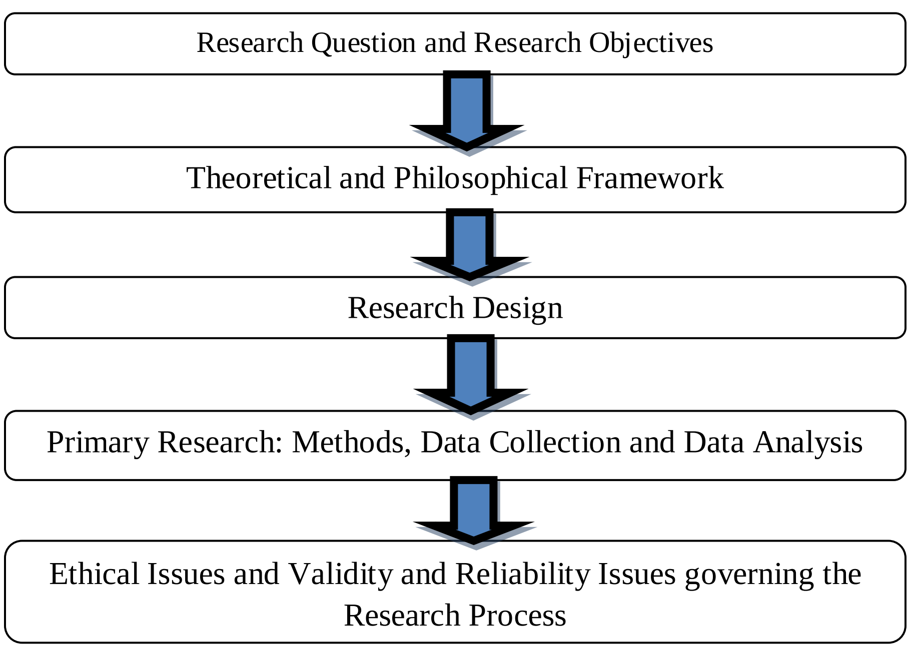

Figure 4.1 Elements of the Research Process (Source: Milner, 2007)

4.3 Research Question and Research Objectives

According to Strauss and Corbin (1998) and Sim and Wright (2000) the formulation of an overarching research question contributes to clarity in the statement of the overall research issue and reflects the researcher's identification of the need for a specific course of inquiry. According to Bryman (2004) research questions are critical in that they serve as a guide for the research exercise from the initial literature researched and design of primary research approach through to the analysis of the data. The primary research objectives arise from the research question which define the research in measurable terms and create boundaries and scope to the study. This ensures that the research is manageable and achievable (Strauss and Corbin, 1998; Zikmund, 2000; Domegan and Fleming, 2003; Kumar, 2005). Zikmund (2000) and Kumar (2005) were of the opinion that the research question and objectives seek to arrive at answers to questions of who, when, where, how and what. Figure 4.2 illustrates the research question and objectives of the study.

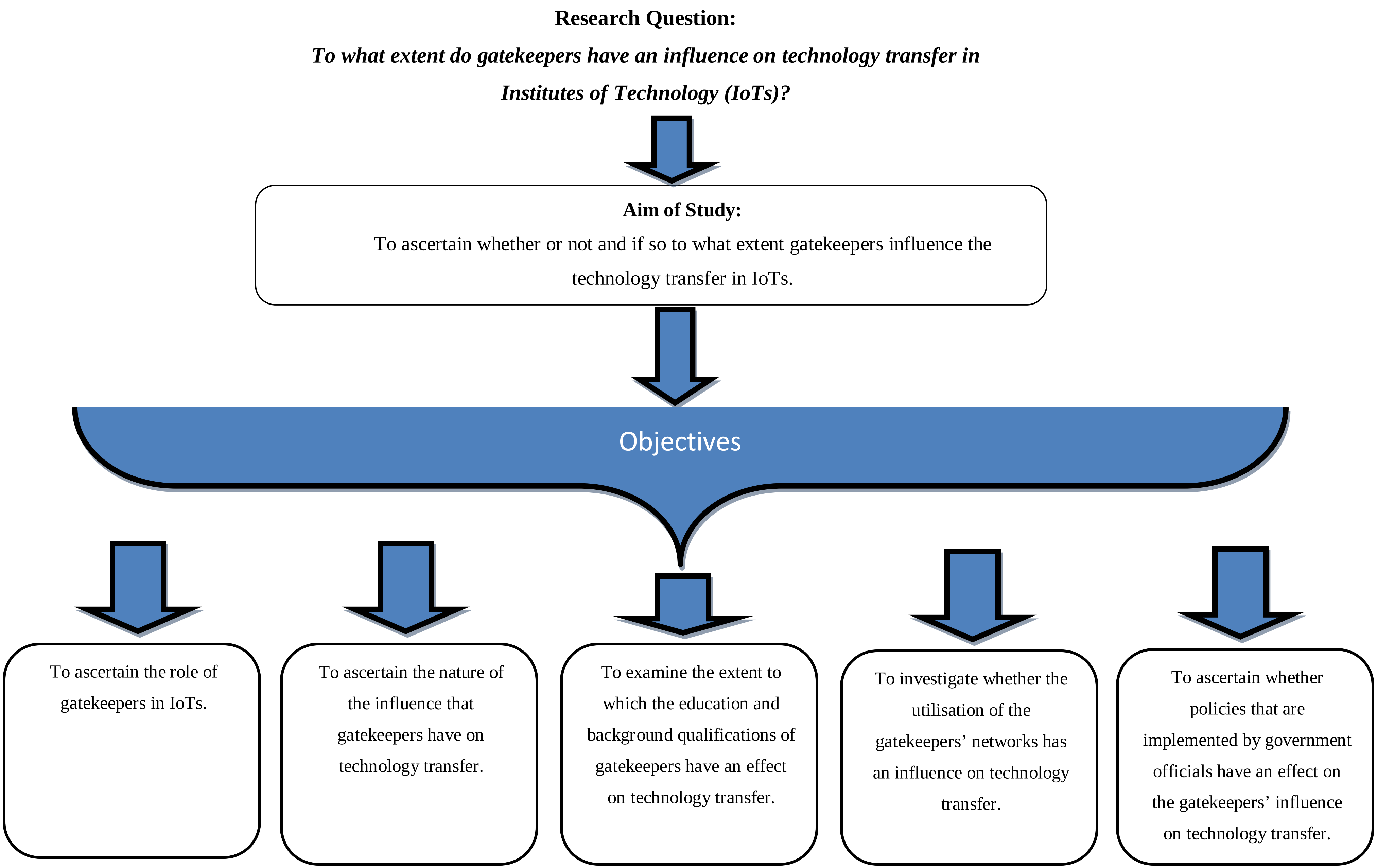

Figure 4.2 Research Question, Aims and Objectives (Source: Current Research)

Figure 4.2 depicts the research question and objectives of this research study. The fundamental focus of the study is to ascertain to what extent gatekeepers' influence technology transfer. The research contributes to literature on technology transfer by examining the influence of gatekeepers on technology transfer. Previous studies, such as that by Goh (2002) emphases that an organisation requires a culture that supports collaboration, leadership, absorptive capacity and trust amongst its employees in order for knowledge transfer to be successful. Therefore, it can be deduced that individuals are required to gather and disseminate the vital knowledge needed to maintain this type of culture throughout the organisation. Through analysis of literature it was found that the transfer of technology depends on the successful transfer of knowledge in the organisation (Garud and Nayyar, 1994). These individuals have been referred to as gatekeepers by Allen (1977) as they possess the ability to absorb knowledge and disseminate it to others within the organisation. While literature refers to gatekeepers in an industry setting, research into gatekeepers within HEIs, more importantly IoTs, has not received as much attention. Therefore, the main objective of this research is to examine how gatekeepers influence the technology transfer process in IoTs.

4.4 Theoretical and Philosophical Framework

At a practical level, Burrell and Morgan (1979) argued that all social scientists approach a research investigation via both inherent and overt assumptions about the nature of the social world and the manners in which it may be explored. These assumptions are outlined in Table 4.1.

Objectivist Approach		**Subjective-Objectivist Dimension**		**Subjectivist Approach**
Realism	⇦	**Ontology**	⇨	Nominalism
Positivism	⇦	**Epistemology**	⇨	Anti-positivism
Determinism	⇦	**Human Nature**	⇨	Voluntarism
Nomothetic	⇦	**Methodology**	⇨	Ideographic

Table 4.1 A Framework for Analysing Research Assumptions (Source: Burrell and Morgan, 1979)

As can be seen from Table 4.1 these assumptions, bounded by subjectivist and objectivist dichotomy embody the issues of ontology (reality), epistemology (knowledge), human nature and the methodology associated with conducting primary research. According to Holden and Lynch (2004) there are significant inter-relationships between these four dimensions in that *"these assumptions are consequential to each other, that is their view [the researchers'] of ontology effects their epistemological persuasion which in turn, affects their view of human nature, consequently, [the] choice of methodology logically flows"* (p.398).

These positions have had bearing on the overall research design, selection of data collection methods and the analysis of data conducted for this research study as it can affect the way in which the researcher approaches his/her study. Furthermore, this study takes into account the opinion of Milner (2007) and trusts that the nature of this research, as reflected in the research question and objectives, has provided an important point of reference from which the researcher can consider the ontological, epistemological and methodological foundations of this research study. Whilst the theoretical and philosophical dimensions are depicted as polar opposites (see Table 4.1), it has also been accepted by Burrell and Morgan (1979) that intermediate positions have emerged and that these in turn have disseminated different ideas and approaches to research. This view was given further credence by Yates (2004) and Milner (2007) who highlighted that a compromise might be reached between ideas and thoughts leading to truth and observed empirical facts which will guide us to truth. Morgan and Smircich (1980), even though they focus on the qualitative aspect of research inquiry, make an attempt to summarise these alternatives. These are presented in Table 4.2. This typology will have some impact on the philosophical orientation and method of this research study.

Objectivist	⟵		⟶			**Subjectivist**
Core Ontological Assumptions	Reality as a concrete structure	Reality as a concrete process	Reality as a contextual field of information	Reality as a realm of symbolic discourse	Reality as a social construction	Reality is a projection of human imagination
Basic Epistemological Stance	To construct a positivist science	To study systems, process, change	To map contexts	To understand patterns of symbolic discourse	To understand how social reality is created	To obtain phenomenological insight
Assumptions about Human Nature	Man as a responder	Man as an adapter	Man as an information processor	Man as an actor	Man as a social constructor	Man as pure spirit, consciousness being
Research Methods	Laboratory experiments and surveys	Historical analysis	Contextual analysis	Symbolic analysis	Hermeneutics	Exploration of pure subjectivity

Table 4.2 Continuum of Basic Assumptions on the Objective-Subjective Debate (Source: Milner (2009) adapted from Morgan and Smircich, 1980).

According to Burrell and Morgan (1979) objectivist research activity is noticeable in the focus and analysis of measureable, hard and objective variables. According to Remenyi, Williams, Money and Swartz (2005) from the subjectivist perspective each situation can be seen as unique and its meaning is a function of the individuals involved and the circumstances. This is particularly important to this study as the research is seeking to explore the influence of gatekeepers on technology transfer activity in IoTs. On the other hand, Holden and Lynch (2004) also present the alternative perspective by noting that the terminology of qualitative, anti-positivist, phenomenology, humanist, interpretivist and social constructionist have become synonymous with the subjectivist approach. Table 4.3 categorises some of the more common terms related to subjectivism and objectivism and their related paradigms.

Objectivist	Subjectivist
Quantitative	Qualitative
Scientific	Phenomenological
Experimentalist	Humanist
Traditionalist	Interpretivist
Functionalist	Social Constructionist

Table 4.3 Common Terms in Research Theory (Source: Holden and Lynch, 2004, p.4)

4.4.1 Ontological Position of research study

According to Easterby-Smith, Thorpe and Lowe (2002) ontology embraces the basic nature of social entitles and reality and ascertains whether these are dependent of individual consciousness (Jankowicz, 2005). Burrell and Morgan (1979) and Saunders, Lewis and Thornhill (2003) stated that ontology could be portrayed as either realism or nominalism. Realism is founded on the assumption that reality is independent of human beliefs and thoughts (Easterby-Smith, Thorpe and Lowe, 2002) while nominalism takes the opposing view that reality is a projection of the human imagination and a product of individual consciousness (Morgan and Smircich, 1980). Bryman (2004) stated that the ontological position of research will be reflected in the research question and will influence the design of the research and collection of data. In terms of the philosophical orientation of this study an ontology of nominalism is accepted as the focus of this research is to whether or not gatekeepers' presence in IoTs has an influence on technology transfer activity.

4.4.2 Epistemological Position of research study

Crotty (1998) stated that epistemology was comprised of the theory of knowledge which is embedded in both the theoretical perspective and methodology while Schwandt (2001) implied that epistemology was the study of the nature of knowledge and justification. Figure 4.3 illustrates the interrelationships and respective contributions of epistemology, methodology and method and has been described by Carter and Little (2007) as an example of research action. In simplest terms, methodology justifies the method which produces data and analysis. Knowledge is created from data and analyses and epistemology modifies methodology and justifies the knowledge produced (see Figure 4.3).

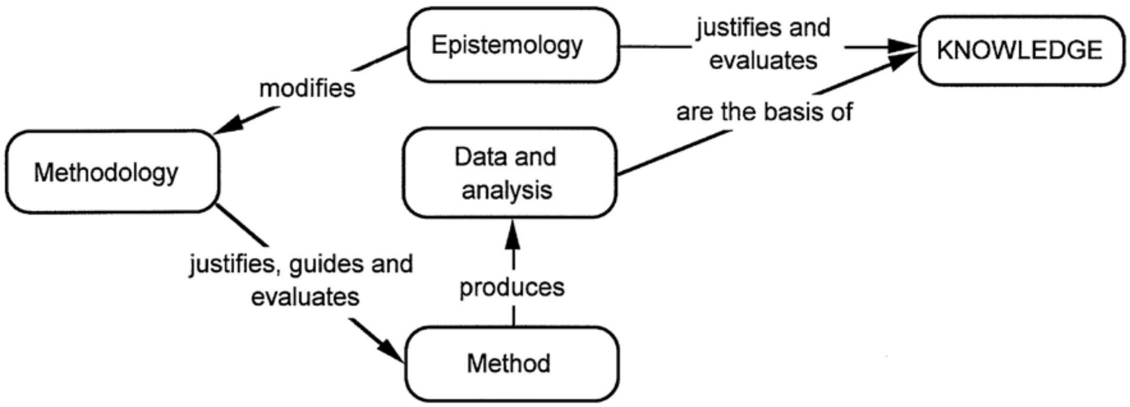

Figure 4.3: The Simple Relationship between Epistemology, Methodology, and Method (Source: Carter and Little, 2007, p. 1317).

Epistemology deals with the nature of knowledge; its possibility, scope and general basis (Hamlyn, 1995). Maynard (1994) explained the relevance of epistemology in that it is concerned with providing a philosophical grounding for deciding what kinds of knowledge are possible and how it can be ensured that they are both adequate and legitimate. Crotty (1998) stated that there was "*quite a range*" of epistemologies (p.8). Constructionism is one of the most commonly referred to of epistemologies (Crotty, 1998) and rejects the objectivism view of human knowledge. According to Robson (2002), constructivist researchers have serious difficulties with the notion of an objective reality. Researchers using this epistemology need to understand the multiple social constructions of meaning and knowledge. Therefore, researchers tend to use research methods such as interviews and observation which allows them to acquire multiple perspectives. Constructionism, according to Crotty (1998) is the epistemology that qualitative researchers tend to invoke.

Another epistemology is objectivism which states that meaningful reality exists apart from the operation of any consciousness. In order to illustrate the meaning of objectivism, Crotty (1998) used the symbolism of the tree in the forest. He stated that a tree is a tree regardless of whether anyone is aware of its existence or not. In this objectivist view, understandings and values are considered to be objectified in the people studied and the objective truth can be discovered.

According to McGrath (2008), denying the importance of individual subjectivity by adopting an objectivist approach may result in a generalisation of respective individual's social changes and interactions in their overall relationships. According to Hussey and Hussey (1997) the objectivist approach is only used to test hypotheses and generalisation while constructionism uses research methods such as interviews to obtain multiple perspectives on a subject. In contrast to this is the subjectivist epistemology where meaning does not come from interplay between the subject and object but is imposed on the object by the subject. Burrell and Morgan (1979) stated that this paradigm places considerable stress upon getting close to a subject by exploring subjective meanings, generating data and researching everyday settings in small samples.

At a practical level, Burrell and Morgan (1979) argued that all social scientists approach a research investigation via both natural and evident assumptions about the nature of the social world and the manners in which it may be explored. As suggested by Remenyi, Williams, Money and Swartz (1998), there are several major questions that require significant consideration by researchers such as 'How to research?' and 'What to research?' However, central to the researchers' answers is their perspective on 'Why research?' As a researcher reviews the philosophical literature, they quickly appreciate that choosing a research methodology involves something much deeper than practicalities, it necessitates a philosophical response to 'Why research?'(Holden and Lynch, 2004). Holden and Lynch further stated that the assumptions of the researcher are consequential to each other and the researcher's view of ontology affects their epistemological persuasion which in turn affects their view of human nature. This in turn leads to the researcher's choice of methodology.

Brannick (1997) noted that what academic researchers accept as scientific knowledge fully depends on their philosophy of knowledge i.e. their chosen epistemology with Balnaves and Caputi (2001) stating that the philosophical and theoretical underpinning of research can affect what the researcher counts as evidence. There are two main paradigms associated with the epistemology stance which are positivist and anti-positivist approaches. According to Burrell and Morgan (1979), Bryman (2004) and Kumar (2005) the approaches are separated by the debate as to whether the methodology and supporting approaches can be applied to the study of social phenomena. According to Bentz and Shapiro (1998), positivism is a complex, composite phenomenon, and also a controversial set of ideas; therefore, it is not just a theory of knowledge but a cultural and political orientation. Burrell and Morgan (1979) defined positivism in social science as *"an epistemology which seeks to explain and predict what happens in the social world by searching for regularities and causal relationships between its constituent elements"* (p.21). Central to this are a number of characteristics including:

- Naturalism- which assumes that all phenomena can be studied and explained in the same way through the adoption of scientific methods;
- Phenomenalism- which assumes that only knowledge based experiences that are observed are robust and that the real world can be measured directly;
- Nominalism- sees words as only reflections of things and only those ideas directly experienced by the senses are meaningful;
- Atomism- views objects of a study in their smallest units and focus on individuals and individual units;
- Scientific laws- which seek to locate empirical regularities through observations and from this, develop laws and general statements which hold across a variety of contexts;
- Facts and Values- facts enable empirical verification through observation and measurement and hence may be regarded as scientific and additionally, limit and isolate the value system of the researcher. (Lee, 1991; Black; 1999; Yates, 2004).

The basic tenets of interpretive/anti-positivist/phenomenological research are virtually the reverse of those that characterise positivism (Burrell and Morgan, 1979; Lee, 1991; Jankowicz, 2005) or social constructionist (Easterby-Smith, Thorpe and Lowe, 2002) perspective. As defined by Patton (1990), the anti-positivist paradigm seeks to understand human experience holistically and inductively. It recognises the researcher as the instrument, taking into account the researcher's experiences and perspectives and seeing them as valuable to the research being undertaken (Lincoln and Guba, 1985). It is an approach that is committed to studying meaning and human phenomena in context. According to Neuman (1997) phenomenology research should explore *"…..socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social worlds"* (p.68). The general anti-positivist view is founded on the belief that the focus of the social sciences is fundamentally different from the natural sciences and requires the researcher to attempt to interpret the meaning with social interactions and experiences (Milner, 2007; Easterby-Smith, Thorpe and Lowe, 2002).

Jankowicz (2005) identified the following characteristics of the phenomenological approach:

- Individual phenomena may be examined and analysed in terms of issues;
- Data may be collected by both participants and observers and with varying levels of involvement and detachment on their part;
- It is difficult to determine the truth in an absolute sense. Differences may also need to be accepted;
- The objective of research and enquiry is to achieve understanding with a view to predicting future outcomes.

Saunders, Lewis and Thornhill (2003) stated that phenomenology takes the position that reality is socially constructed and that it is necessary to explore the subjective meanings motivating people's actions in order to understand them. Fisher (2004) clarified this by saying that the understanding of reality is not a simple account of what is, rather it is something that people form from their interpretations of reality, other people's interpretations and the compromises and agreements that arise out of negotiations between the two. So in essence positivism relates to experimental and descriptive techniques and phenomenology relates more to qualitative research and observation and exploratory techniques. However, while depicted as opposites of the same continuum, the two positions can be reconciled to varying degrees, where mapping contexts and understanding the creation of social reality, adopt intermediary positions (Morgan and Smircich, 1980) as can be seen from Table 4.2.

In relation to the study described in this thesis and its epistemological position, the research is positioned within the general anti-positivist/phenomenological domain and fits with many or most of the characteristics outlined by Saunders, Lewis and Thornhill (2003) and Jankowicz (2005). In particular, the research question and objectives focus on experiences and influences of gatekeepers in IoTs and aims to extract both a depth and richness to understanding the interactions between gatekeepers and academic communities and also the knowledge transfer abilities of the gatekeepers. Furthermore, the external influences on the gatekeepers are recognised within the IoT setting and where the researcher is unable to completely detach himself/herself from social interactions and phenomena within the study. As such, there are elements of the research study which lean towards the phenomenological stance, and towards the positivist paradigm in that the research is governed by literature from authors such as Goh (2002) and Allen (1977) although it is limited. On balance, this research is utilising more of a phenomenological stance in order to interpret understanding from the gatekeepers' personal stance and context (Burrell and Morgan, 1979). This type of research usually incorporates small samples, which are orchestrated to qualitatively capture the totality of the research within its operational setting (Remenyi *et al.*, 2005) relying on an inductive approach, where observations from the data contribute to the exploration and understanding of the research and theoretical focus (Gill and Johnson, 2002). In addition, a pragmatic methodologically plurist approach is adopted with recognises that prior knowledge has informed the primary research as illustrated in Chapter 3.

4.4.3 Human Nature Position of research study

The assumptions made about human nature also inform the philosophical underpinnings of the research process (Morgan and Smircich, 1980). A research study that is objective in nature responds to external stimuli within the social environment (determinism) (Gill and Johnson, 2002) or as Morgan and Smircich (1980) describe it '*man as a responder*'. In contrast from a subjective viewpoint, voluntarism assumes that individuals shape their world and exercise free will and are not subject to external influences. What is particularly relevant to this research study, is as Burrell and Morgan (1979) contend that both positions may be adopted in that gatekeepers in IoTs may be governed by and react to the forces within their IoT however, may also have individual autonomy and exercise free will which can impact on their behaviour. Consequently, the research is likely to occupy an intermediary position on the human nature continuum as outlined by Morgan and Smircich (1980), see Table 4.2.

4.4.4 Methodological Position of research study

The following section discusses some methodological and practical issues in order to progressively narrow down and finally spell out a method for conducting the study. The epistemological, ontological stance taken during the research will influence the methodological position and overall research strategy adopted (Burrell and Morgan, 1979; Morgan and Smircich, 1980 and Bryman, 2004). Crotty (1998) described the determination of an appropriate methodology as *"the strategy, plan of action, process or design lying behind the choice of particular methods and linking the choice and use of methods to the desired outcomes"* (p.3)

According to Burrell and Morgan (1979) and Easterby-Smith, Thorpe and Lowe (2002), while clear distinctions can be made at the philosophical level, this may not be as obvious in methodological terms. Revisiting Table 4.1, the methodology within this framework may be viewed as being nomothetic or ideographic. Yates (2004) identified nomothetic methodologies as having a goal to construct generalisable laws while ideographic methodologies aim to create detailed descriptions of particular circumstances. Gill and Johnson (2002) summarised these perspectives and possible methodologies that can be employed. These are shown in Table 4.4.

Nomothetic methods emphasise	Ideographic methods emphasise
1.Deduction	1.Induction
2.Explanation via analysis of causal relationships and explanation by covering laws	2.Explanations of subjective meaning systems and explanation by understanding
3.Generation and use of quantitative data	3.Generation and use of qualitative data
4.Use of various controls, physical or statistical, so as to allow testing of hypotheses	4.Commitment to researching everyday settings, to allow access to, and minimise reactivity among the subjects of the research
5.Highly structured research methodology to ensure replicability of 1,2,3 and 4	5.Minimum structure to ensure 2, 3, and 4.

Table 4.4 A comparison of nomothetic and ideographic methods (Source: Gill and Johnson, 2002).

According to Milner (2007) the nomothetic approach mirrors the positivist perspective and philosophy for conducting research. Gill and Johnson (2002) outline that the approach is highly deductive where theoretical and conceptual hypotheses are established and then tested and subjected to empirical scrutiny. The approach is likely to utilise quantitative data with a highly structured research methodology and may lend itself to research designs such as experimentation and surveys. In contrast the ideographic approach utilises a more inductive position where observations contribute to the development of theory and explanations of what has been observed (Gill and Johnson, 2002). This reflects a more anti-positivist prospective and a methodology which generates qualitative data from research conducted in everyday settings with an objective of gaining an insight into situations.

As mentioned previously, this current research study utilises elements from both the positivist and anti-positivist paradigms. What also becomes clear is that research is not always conducted as purely an inductive or deductive study. This is reflected in Table 4.2 and also in the wider debate around quantitative and qualitative research brought forward by Lee (1991), Barbour (1999) and Onwuegbuzie and Leech (2005). If one was to choose a qualitative means to conduct a piece of research, the study would lend itself to an emphasis on words and would utilise an anti-positivism epistemology and an otology of nominalism. Likewise a research study that utilises a quantitative methodology would rely on measurements and a positivist and realm stance. However, this researcher is aware that a qualitative methodology does not directly relate to an interpretivist philosophy nor is it true to state that all studies using a quantitative stance would be positivist in nature. Instead, research methodology is dependent upon the underlying philosophical assumptions of the researcher. Belk (2007) argued that it is possible to conduct interpretive research that utilises quantitative methodology while also remaining true to the philosophical underpinnings of interpretive research. For Bryman (2004) *"quantitative and qualitative research represents different research strategies and each carries with it striking differences in terms of the role of theory, epistemology issues and ontological concerns. However, the distinction is not a hard and fast one: studies that have the broad characteristics of one research strategy may have a characteristic of another"* (p.21).

David and Sutton (2004) further support this view that regarding qualitative and quantitative research there are a number of blurred distinctions which are not absolute with Bryman (2004) adding that both strategies are seen as compatible and that there is an acceptance of the philosophical assumptions on which each is based but also acknowledging that the methods associated with each are independent. Gill and Johnson (2002) stated that this results in methodological pluralism with Onwuegbuzie and Leech (2005) advocating that this represents taking the pragmatist position. This position becomes evident in practice where research that has a degree of qualitative orientation can still be informed by existing knowledge, theory and the development of a conceptual framework (Ritchie, 2003). So while this current research is qualitative in nature and is concerned with interpreting meaning in contextual situations and the spoken word rather than in numerical data using statistical methods, this research has evidence of both induction and deduction elements.

In summary, the theoretical and philosophical position of this study is supported by an anti-positivist/interpretative/phenomenological epistemology which also assumes an ontology of nominalism and a methodology that acknowledges both nomothetic and ideographic positions and adopts a pragmatic approach to research. This methodological pragmatism is reflected in the fact that a conceptual framework to represent this study has already been developed which implies that a degree of prior learning and knowledge has been brought to the primary research implementation.

4.5 Research Design

Having analysed the ontological, epistemological and methodological position of this study, the next phase of the philosophical and methodological consideration is choosing the most appropriate research design which serves to answer the research question and achieve the research objectives outlined previously. According to Ghauri, Granhaug and Kristianslund (1995), the choice of research design influences subsequent research activities and it is essential that the research problem is understood if irrelevant research design choices are to be avoided. Before a research design is chosen it is important that each available approach is examined to analyse whether the research study encompasses an exploratory, descriptive or causal research design (Domegan and Fleming, 2003). Table 4.5 describes these research designs.

	Exploratory Research	Descriptive Research	Causal Research
Data Type	Qualitative	Qualitative or Quantitative	Quantitative
Aims	To explore, chart, identify	To describe, quantify	To establish cause and effect
Nature of variables	Unknown, undocumented	Known associations and documented	Known exactly, clearly supported
Degree of Formality	Relatively little	Some to extensive	High mathematical content
Data	Literature review Expert Surveys Focus groups in-depth interviews projective techniques	Literature review surveys observation panels	Literature review expert survey Experiments surveys observations
Sample Size	Small	Small or large	Large
Question Types	Probing Response driven	Some probing Interviewer driven	No probing
Hypothesis	Generates, develops	Tests and/or generates, develops	Tests

Table 4.5 Considerations in Choosing a Research Design (Source: Domegan and Fleming, 2003)

Where the research is exploratory in nature it is accepted that the research will to some extent uncover and reveal patterns, trends, attitudes and behaviours that were previously unknown (Kumar, 2005). Studies of this nature rely on qualitative data generated from small samples with a reliance on in depth interviews as a means of exploring key issues. Causal research seeks to identify cause and effect associations and relationships between two or more variables (Domegan and Fleming, 2003). It is characterised by the generation of quantitative data from large samples. Descriptive research is particularly relevant to determining experiences, attitudes and needs of individuals (Sim and Wright, 2000).

Utilising Domegan and Fleming's (2003) research design framework, descriptive research is deemed the most suitable for this study in comparison to exploratory or causal research. Kane (1995) stated that descriptive research involved finding out what is or what has happened in terms of the research phenomenon which may or may not involve *"describing attitudes, behaviours or* *conditions"* (p.13). In addition, the data generated is predominantly of a qualitative nature, emanating from a small sample to probe and capture depth to the information (Denzin and Lincoln, 2008), as opposed to measurement or comparison of quantitative data from large or multiple samples (Balnaves and Caputi, 2001). Domegan and Fleming (2003) also recognise that although quantification is recognised as a possible aim of descriptive research, description may also arrive from qualitative data and as such Hakim (2000) argues *"qualitative research tends to be used most heavily in disciplines where the emphasis is on description"* (p.37) which has relevance for the primary research part of this study. Moreover, the research is not concerned with testing hypothesis; it is more concerned with describing social systems, relations or social events (Sarantakos, 2005). Furthermore, the degree of formality in the research process is semi-structured and researcher driven, allowing flexibility and probing where appropriate compared to an unstructured process (Domegan and Fleming, 2003).

As a result of the prior knowledge collected from the literature reviewed and the development of a conceptual framework to arrive at the research question, Malhotra and Birks (2003) acknowledge that descriptive research designs may be symbolised by prior outlining of specific research questions and furthermore, the research design may be pre-planned and structured to a degree to accommodate the research question. Within the anti-positivist methodological underpinning and the descriptive research design taken for investigating the influence of gatekeepers on technology transfer activity in IoTs, the necessity to capture the research phenomenon, the research respondents, context and setting provided the rationale for pursuing a qualitative inquiry into the research question and objectives utilising semi-structured interviews.

As the research in this thesis is taking an anti-positivist stance, utilising a descriptive research design and pursuing a qualitative inquiry in an attempt to provide answers to the research question, the data gathering techniques are also qualitative in nature. Of the many methods of gathering qualitative data available, some are better suited to an anti-positivist stance then others. The most common methods include interviews, conversations, participant observation, action research and analysis of personal texts (Lester, 1999). Wertz (2005) stated that the key quality in the data sought by interpretivists is concreteness. Interviews, that are conducted within the anti-positivist stance for example, will tend to ask participants to describe their experience concretely by posing such questions as: Could you describe your day? Or can you describe a particular incident in more detail? This way of opening dialogue is valued over and above asking more general abstract questions (Finlay, 2008). Mason (1996), Fontana and Frey (1998) and Sarantakos (2005) identified that interviews would be appropriate to capture individuals' meanings and interpretations, reason processes and social norms within a naturalistic setting. However, interviewing can be intimidating and daunting for both the interviewer and interviewee alike, because usually in an interview setting people have not met each other previously. It can also be a complex and lengthy encounter (Curran and Blackburn, 2001).

Other methods associated with the qualitative inquiry are questionnaires, case studies and participant observation. Questionnaires have numerous advantages, namely the short time to complete and their unobtrusive nature (Robson, 2002). However, there are a number of issues with this method such as the difficulty of capturing relational issues, the lack of opportunity to probe respondents and uncertainty regarding their response rates (Bryman and Teevan, 2005). Case studies, on the other hand, require a longitudinal time frame which this study did not have and also involves an intensive study of a specific individual or specific context (Yin, 2002; Trochim, 2006). The research in this study, however, is examining the effect of gatekeepers across six IoTs; therefore it does not relate to a specific context or individual. Participant observation was also a technique that could be utilised as a data collection method. This method can be very demanding on the researcher and requires that the researcher becomes a participant in the culture or context being observed and often requires that the researcher be involved for months, even years on the study (Trochim, 2006). Participation was therefore, not considered a probable method for this study as the study did not require such in-depth involvement for that type of time frame as suggested by Trochim (2006).

As this research has adopted an anti-positivist philosophy and descriptive research design, qualitative research methods in the form of interviews were adopted. According to Easterby-Smith, Thorpe and Lowe (2002), there are a variety of structures to the interviewing process. They can be highly formalised and structured, for example in market research, or they can be quite unstructured akin to free–ranging conversations. As this research was designed to ascertain the extent of gatekeepers' influence on technology transfer in IoTs, semi-structured interviews were adopted in an attempt to generate *"thick description"* (Gilmore and Carson, 1996, p.22) in terms of a detailed insight into gatekeepers.

4.6 Semi-structured interviews as a method of qualitative inquiry

Kvale (1996) and Groenewald (2004) remarked that data gathering during the qualitative interview is literally an interchange of views between two persons conversing about a theme of mutual interest, where the researcher attempts to understand the world from the subject's point of view to unfold meaning of people's experiences. Interviews often represent a compromise between more structured, qualitative data collection methods and in-depth qualitative methods. Interviews were chosen as the primary research method for this study based on the philosophical underpinning discussed earlier in this chapter and with reference to the overall research design strategy (Mason, 1996; Gill and Johnson, 2002) and also to strengthen the validity and reliability of the research. Specifically, the ontological position of this study indicates that respondents' knowledge, views and understanding and interactions are meaningful properties of social reality (Burrell and Morgan, 1979). In addition the epistemological position taken infers that knowledge may be generated using interviews to access respondents' accounts of reality to determine what constitutes as evidence in terms of their understanding around the research issue (Easterby-Smith *et al*., 2002).

Interviews can vary in terms of the level of their structure and can either be structured (Kumar, 2005; Saunders *et al*., 2007) or unstructured (Silverman, 2006). Zikmund (2000) and Bryman (2004) stated that an intermediate semi-structured approach may serve to generate flexibility during the course of the interview. Through using this structure it is possible to obtain information about personal, attitudinal, and value-laden material which calls for social sensitivity in their own right (Jankowicz, 2005). It was this approach that was deemed most suitable to accommodate the primary research needs of this study by moving away from the rigidity of a predefined line of questioning towards a situation where the interview style may be modified to facilitate follow-ups and probes and also to explore non-verbal cues (posture, pauses, raised voices etc.) which may arise (Sarantakos, 2005). Semi-structured interviews were utilised in this research with the aim of discovering whether gatekeepers had an influence on technology transfer and understanding the world in which they operate.

Through using a semi-structured (informal) interview technique, the researcher will be able to find out more information about the setting of the person. The interview is reciprocal as both the researcher and the research subject are engaged in dialogue. The interviews were conducted in an open ended manner as per the writings of Maylor and Blackmon (2005). Semi-structured interviews allowed the interviewer to gather information through a set of pre-defined questions. Unlike structured interview techniques, the interviewer did not strictly stick to a pre-defined set of questions but instead allowed a free flowing conversation to take place. If the interview took an unpredicted course the interviewer reverted back to the pre-defined questions. Furthermore, each theme had a subset of questions for probing to add clarity to the understanding of the respondents' responses as commented in by Burns and Bush (2000) Bryman (2004) and Jankowicz (2005).

Through reducing the degree of structure in the interviews the researcher was able to obtain descriptions of the gatekeepers' experiences. Therefore, the researcher added to the validity of the information collection by utilising Baker's (2003) suggestion that the interviewee would have more freedom to express precisely how they think and feel about technology transfer, as the question wording was altered and explanations given regarding what the question was trying to achieve. Also questions that may appear to be inappropriate for the gatekeepers could be omitted and further questions asked instead. The interview guides for the three different sets of key informants are listed in Appendices 4, 5 and 6. The next section of this chapter examines the data collection methods employed.

4.7 Identification of Research Sample

In terms of identifying who to interview and complementing the interpretivist/phenomenological nature of the research undertaken, a non-probability sampling strategy was adopted (Domegan and Fleming, 1999). Mason (1996) and Kumar (2005) argued that sampling should not rely on statistics and probability and therefore, interpretative research tends to rely on purposeful sampling techniques of small samples of respondents that are situated in the organisational context. The respondents were intentionally sought as they met pre-defined criteria. Therefore, this study is using purposive sampling, considered by Welman and Kruger (1999) as the most important kind of non-probability sampling, to identify the primary participants. The sample for this study was selected based on the purpose of the research (Babbie, 1995; Schwandt, 1997), which was to understand the influence of gatekeepers on technology transfer in IoTs.

Consistent with the opinions of Malhotra and Birks (2003) in that this research is characterised by prior literature reviewed, the process of identifying a suitable sample for this research was informed by research from Rice and Matthews (1993) and Duff (1994) who stated that incubation centres and their managers were drivers of technology transfer. The sample population for this research consisted of the campus incubation centres located in the 14 IoTs in Ireland. It is important to note that one of the IoTs had two incubation centres therefore; the total sample population consisted of 15 incubation centres. As mentioned in Chapter 2, the IoTs are located throughout Ireland and due to time constraints, it was not possible to interview all 15 incubation centres therefore, the researcher only included the best performing and most established centres. A sample of the 15 campus incubation centres needed to be established. Malhotra (1999) defined a sample as a subgroup of the population selected for participation in the study being undertaken. In order to obtain the sample a set of selection criteria was derived from sources such as Proton Europe, Enterprise Ireland and the OECD and academic researchers which measured the campus incubation centres in aspects of best practice such as technology transfer and knowledge transfer (See Table 4.6).

As can be seen from Table 4.6, there were a number of selection criteria which the researcher used to obtain a suitable sample of campus incubation centres in the 14 IoTs. As the researcher wanted to select the best performing IoTs from the sample, questions were asked as to their technology transfer activity and knowledge transfer activity. Similarly, as the study wanted to establish the best performing IoTs the performance of their campus incubation centres was also measured as Rice and Matthews (1993) were of the opinion that incubation centres were the hub of technology transfer. Spann, Adams and Souder (1995) developed an initial framework of technology transfer activity measurement metrics which included the number of patents, licenses, start-up companies and invention disclosures. Furthermore, Polt, Rammer, Schartinger, Gassler and Schibany (2001), benchmarked the types of knowledge interactions between universities and firms and used measurements such as the number of spin-in companies, spin-out companies and academic researchers engaged with the incubation centre to measure knowledge transfer activity. The researcher took these measurements into account in order to develop a list of selection criteria for the study. In order to establish a comprehensive set of criteria for measuring campus incubation activity the research used additional sources such as Proton Europe and the OECD. Consequently, a set of criteria was employed which measured incubation best practice and included the number of years in existence, occupancy rate, tenancy rate and number of people employed by the incubation centre companies.

Selection Criteria	Preferred Benchmark Target
Number of years incubation centre is in existence	5
Number of academic researchers engaged in research in incubation centre	6
Number of spin-in companies located in incubation centre	10
Number of spin-out companies located in incubation centre	2
Number of start-up companies located in the incubation centre	5
Number of patents executed	8
Number of licenses executed	11
Number of invention disclosures executed	18
Number of people working for the centre	11
Number of client companies located in the centre	20
Occupancy rate for the centre	85%
Tenancy rate (years) for the centre	3
Number of people employed by client companies (average)	6

Table 4.6: Selection Criteria for IoTs (Source: Current research).

Benchmarks	5	10	2	6	5	8	11	18	20-50	20-30	85%	3	6
IoT	Years	Spin-ins	Spin-outs	Academic Researchers	Start-ups	Patents	Licenses	Invention disclosures	Jobs created	No. Clients	Occupancy rate	Tenancy rate	Employees per company
IoT1	3.00	42.00	0.00	0.00	42.00	40.00	4.00	0.00	160.00	40.00	100%	33.00	3.00
IoT2	3.00	20.00	2.00	8.00	22.00	2.00	0.00	0.00	60.00	18.00	90%	33.00	0.00
IoT3	11.00	18.00	2.00	6.00	16.00	2.00	4.00	3.00	120.00	27.00	75%	36.00	3.00
IoT4	3.00	0.00	4.00	1.00	20.00	4.00	0.00	0.00	42.00	20.00	80%	33.00	7.00
IoT5	4.00	18.00	5.00	4.00	18.00	5.00	2.00	0.00	30.00	70.00	80%	33.00	4.00
IoT6	20.00	15.00	0.00	6.00	12.00	5.00	0.00	5.00	500.00	25.00	80%	36.00	3.00
IoT7	17.00	32.00	1.00	5.00	32.00	Did not know	Did not know	Did not know	1000.00	32.00	100%	12.00	3.00
IoT8	3.00	5.00	1.00	4.00	5.00	0.00	1.00	1.00	15.00	6.00	100%	33.00	3.00
IoT9	3.00	7.00	0.00	0.00	22.00	6.00	2.00	0.00	26.00	18.00	100%	36.00	4.00
IoT10	2.50	30.00	0.00	15.00	25.00	7.00	1.00	0.00	50.00	30.00	100%	36.00	6.00
IoT11	9.00	11.00	1.00	7.00	8.00	2.00	0.00	2.00	0.00	30.00	70%	48.00	4.00
IoT12	2.50	3.00	15.00	0.00	14.00	0.00	0.00	0.00	42.00	18.00	100%	33.00	5.00
IoT13	3.50	7.00	3.00	6.00	16.00	3.00	8.00	0.00	56.00	25.00	80%	33.00	6.00

Table 4.7 Selection Criteria Results (Source: Current research)

The results of the selection criteria are shown in Table 4.7 with the selected sample highlighted. Two IoT incubation centres were removed from the sample as they asked to be removed from the study. The remaining 13 IoT incubation centres were therefore included in the sample. The sample of incubation centres was chosen based on the results of the selection criteria. It is important to note that all the incubation centres did not meet all the research criteria, those incubation centres that had the best fit were included in the study. In order to reduce bias the current researcher took the fairest approach possible.

As can be seen from Table 4.7 the IoTs chosen to be part of this study were IoT1, IoT2, IoT3, IoT6, IoT10 and IoT13. It must be noted that these IoT incubation centres did not meet all the preferred benchmark targets so while IoT1, IoT2 and IoT10 were not in existence for five years they did meet the target for number of spin-ins, start-up companies, jobs created, number of jobs and tenancy rates. Furthermore, even though IoT6 and IoT10 did not have two or more spin-out companies or eight patents they did match the preferred targets for number of academic researchers, start-up companies, jobs created, number of clients, occupancy rate, tenancy rate and number of employees per company. Also it can be seen that IoT3 did not match the preferred target of patents, licenses and invention disclosures however, it did match the preferred benchmarks for jobs created, number of clients, occupancy rate, tenancy rate, spin-in and spin-out companies. Once finalised the campus incubation managers of the chosen sample were contacted again so that a convenient time could be arranged to perform a more in-depth interview.

The primary aim of this research was to ascertain the influence of gatekeepers on technology transfer in IoTs. As this descriptive research was informed by prior knowledge from Duff (1994) that managers of incubation centres were the gatekeepers of technology transfer, the researcher used the incubation centre managers as the primary interview respondents to ascertain the influence of gatekeepers on technology transfer. However, during the course of interviewing the managers it became apparent that they did not consider themselves to be gatekeepers of technology transfer in the IoTs but rather facilitators of the process. Table 4.8 summaries the number of gatekeepers identified by the incubation managers in each IoT.

Institute of Technology	Number of Gatekeepers
IoT1	5
IoT2	5
IoT3	3
IoT6	2
IoT10	3
IoT13	5

Table 4.8 Numbers of Gatekeepers in IoTs (Source: Current Research)

The research process and identification of research informants for data analysis is illustrated in Figure 4.4. As can be seen from Figure 4.4, the research sample for this study consisted of six IoTs based on the results of the selection criteria. As this study wanted to ascertain gatekeepers influence on technology transfer in IoTs, the managers of the 6 incubation centres were interviewed. It was discovered from the interviews however, that the gatekeepers considered themselves more as facilitators of technology transfer in IoTs rather than gatekeepers of the process. The managers identified 23 individuals, from the 6 IoTs, who they believed were true gatekeepers of the technology transfer. The researcher contacted all 23 identified gatekeepers and received a 100% response. During the course of interviewing the gatekeepers a number of questions arose as to the funding allocated to IoTs for technology transfer and the policies that were enforced by government funding agencies. As a result, the current researcher identified and interviewed 10 key government officials located in the main funding agencies in Ireland and received a 100% response rate (See Appendix 3). The question guides used to interview the campus incubation managers, gatekeepers and government funding agency officials are listed in Appendices 4,5 and 6.

4.7.1 Pilot Study

A pilot study was conducted on the interview questions for the incubation managers with a manager of a campus incubation centre, a manager of enterprise platform programme and also a researcher in a leading IoT in Ireland in order to ensure its validity. The questions for the gatekeepers were based on the responses accumulated from the incubator managers while the interview questions for the key government officials were formulated from the responses gathered during the gatekeeper interviews. It has been suggested by Teijlingen and Handley (2001) that qualitative data collection and analysis is often progressive, in that a second or subsequent interview in a series should be 'better' than the previous one as the interviewer may have gained insights from previous interviews which are used to improve interview schedules and specific questions. Holloway (1997) also stated that when utilising qualitative approaches separate pilot studies are not necessary. Consequently, a pilot study was not conducted for these sets of interview questions as the questions were determined by current research analysis. Therefore, although there is no specific pilot study for these sets of interview questions, analysis of the earlier interview transcripts helped to improve the further sets of interviews.

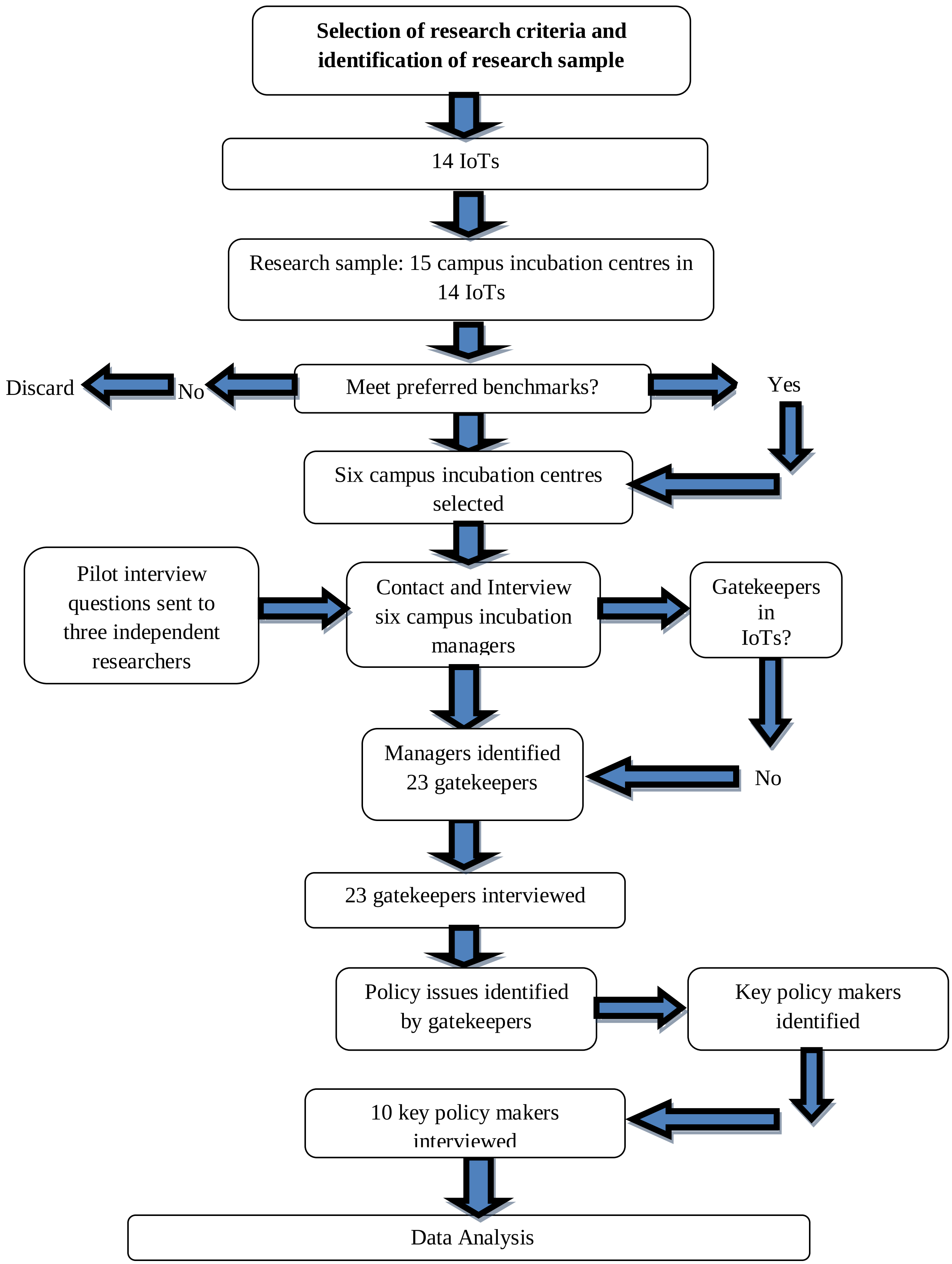

Figure 4.4 Process Flow Diagram of Current Research (Source: Current research)

4.8 Interview Protocol

As the literature review identified the campus incubation managers as gatekeepers of technology transfer in IoTs, the managers of the six incubation centres were contacted in July 2009 with the aim of securing their participation in the study. Each respondent was emailed and contacted by phone where the date and time of the interview and a statement related to confidentiality was confirmed. Each interview was conducted at the interviewees' place of work to facilitate their work schedule and to capture their responses in a natural setting. The same method was applied when contacting the 23 gatekeepers identified by the incubation managers and also the key government officials.

The researcher audio-recorded all 39 interviews with the permission of the interviewees (Bailey, 1996; Arkley and Knight, 1999). Each interviewee was also assigned a code based on the IoT and government funding agency that they worked for. A full list of the codes used for the three cohorts in this research can be seen Appendices 1, 2, and 3. The researcher recorded each interview on a separate tape and labelled each tape with the assigned interview code. As soon as possible after each interview the researcher listened to the recording and transcribed it in full. The researcher tested the recording equipment prior to the interview, as commented on by Creswell (2007) so that the researcher's full attention was on the interview. The researcher also ensured that the recording equipment functioned and that spare batteries, tapes and so on were available at all times. This was emphasised by Easton, McComish and Greenberg (2000) in that equipment failure and environmental conditions might seriously threaten the research undertaken.

All respondents were informed that their participation was voluntary and permission was also sought to record the interview before it started. All respondents gave permission for the interview to be recorded. Jankowicz (2005) emphasised that field notes need to be taken during the course of the interviews in order to capture points of interest to be noted at a later stage, which the researcher did at the end of each interview conducted. According to Groenewald (2004) and Lofland and Lofland (1999), because the human mind tends to forget quickly, field notes by the researcher are crucial in qualitative research to retain data gathered. According to Groenewald (2004) this requires the researcher to be disciplined in the recording of notes subsequent to each interview, but without judgmental evaluation.

The duration of each interview ranged from 30 to 90 minutes with a typical interview lasting 45 minutes. At the conclusion of the interview the respondents were thanked for their participation, permission was sought to contact them again if clarification was needed in the future and most importantly their confidentiality and anonymity was guaranteed.

4.9 Data Analysis

Based on research by Eisenhardt (1989), analysing data collected from this study involved an iterative process of collection and analysis to make sense of the gatekeepers influence on technology transfer activity. In order to classify the data collected from the semi- structured interviews, the researcher transcribed the audio tapes verbatim. Hand-written notes which were taken during the course of the interviews were also transcribed. This approach allowed the researcher to revisit certain transcripts where needed and also provided a complete record of the interview content. Furthermore, the transcripts also noted any non-verbal cues, pauses or raised voices that occurred in the interviews (Robson, 2002; Silverman, 2006; Henn, Weinstein and Foard, 2006). As the number of interviews was of a manageable size the researcher chose to analyse the interviews by hand and not use any software packages as it has been stated by Seidel (1991), Hinchliffe, Crang, Reimer and Hudson (1997) and Barry (1998) that the utilisation of software packages can result in distancing the researcher from the data, can encourage quantitative analysis of qualitative data and in some instances can inadvertently guide the researcher in a particular direction.

In relation to this research, elements of both deductive and inductive approaches are in evidence. The conceptual framework derived from the literature review provided the initial set of overarching themes on which to develop, while the ongoing analysis provides the flexibility for additional themes and sub-themes to emerge. In order to analyse the research data in the most effective way the researcher adhered to the advice of Miles and Huberman (1994) and used visual displays to present the qualitative data so that patterns and numbers could be noted. Furthermore, the researcher also followed the advice of Sandelowski (2001) and used data display tables and numbers to give greater clarity to the qualitative data (Dey, 1993). Therefore, this researcher sought to generate understanding from "....drawing diagrams, tabulating tables and writing text" (Dey, 1993, p.237) to produce a coherent account of the gatekeepers located in IoTs and their influence on the technology transfer process.

4.10 Validity and Reliability

Patton (2001) stated that validity and reliability are two factors which any qualitative researcher should be concerned about while designing a study, analysing results and judging the quality of the study. In adopting an interpretivist -led research design, while it is accepted that research of this type may facilitate a deep understanding of the key issues within a study, the results are nonetheless often criticised in terms of objectivity or rigour (Yin, 2003). Research methodologies can face issues such as researcher bias and lack of generalisation (Bryman, 2004) therefore; researchers need to be prepared for these challenges (Remenyi *et al*., 2005).

To ensure reliability in qualitative research, examination of trustworthiness is essential including whether the research activities are replicable in terms of operationalisation (Kumar, 2005). Yin (2003), when speaking from a case study research aspect, stated that incorporating protocol containing the *"instrument as well as the procedures and general rules"* (p.67) may facilitate another researcher to replicate the research no matter what research design is implemented. Every effort was made to ensure the validity and reliability of the information and therefore all semi-structured interviews were conducted in a standardised manner. Firstly, an interview schedule was documented so that all respondents were interviewed on the same topics and all data was handled in a consistent manner with the researcher transcribing the research in a template format. Also some flexibility in relation to the order of questioning was permitted. Lincoln and Guba (1985) stated that since there can be no validity without reliability, a demonstration of validity is sufficient to establish reliability with Patton (2001) adding that reliability is a consequence of the validity in a study.

In order to increase the reliability of the study, the researcher ensured the highest standards of validity were adhered to. Cooper and Schindler (2003) argued that good internal validity requires agreement on the features or elements that will constitute a sample representation of the research interest. The process of semi-structured interviews enforced in this study reinforces internal validity by gathering multiple sources of evidence from multiple sources of respondents.

External validity relates to the issue of the replicability of findings outside of the interview process. In order to ensure the replicability of the study, the research process was designed in such a manner that the methodology derived from the research could be used in other higher education institutions in Ireland to examine and ascertain the influence that gatekeepers have on the technology transfer process.

Furthermore, the researcher established credibility through describing the settings, the participants and the themes of the study in rich detail in order to increase the validity of the study. The researcher adhered to the suggestions of Denzin (1989) by using deep detailed accounts of the history of the education system in Ireland, the gatekeepers' roles in the IoTs and location so that the reader could experience the research and understand the context being described in the study. As mentioned previously in this chapter this study is utilising an interpretative stance to contextualise the individuals being studied. This gives further credibility to the study through writing thick descriptions of the data and providing details of how the informants feel and interact with each other. With this vivid detail, the researcher helps readers to understand that the data is credible. Finally, in order to ensure the validity of the study, the researcher had the data peer reviewed by a colleague who was familiar with the research topic. The peer reviewer and their opinions forced the researcher to study the method and interpretation of the data being analysed. By seeking the assistance of the peer reviewer, the researcher added credibility to the study (Creswell and Miller, 2000).

Validity of the interview data collected was also adhered to with pilot interviews conducted for the incubator manager interview questions in advance with the manager of a campus incubation centre, a manager of enterprise platform programme and also a researcher in a leading IoT in Ireland. Remenyi *et al.* (1998) stated that colleagues can be used as a pre-tester for the interview questions as it provides the opportunity to assess such things as the clarity of the questions and the ability to perform meaningful analysis of the evidence obtained. This exercise was deemed very worthwhile because it allowed the researcher to test if the interview questions were relevant, clear, concise or repetitive and to determine if they would yield worthwhile data. The respondents commented and made suggestions which were incorporated into the redesign of the questionnaire. Examples include re-wording some of the questions so that they would be clearer for the respondents to understand.

4.11 Ethical issues governing the research process

Throughout the research design process, ethical issues were considered in relation to the treatment of the respondents and also the management and storage of the data that was collected as per the structures set out by Saunders, Lewis and Thornhill (2007). The researcher has taken these into account and decided to adopt the following set of ethical research standards. With regard to the semi-structured interviews, all issues concerning confidentiality and anonymity were and will be respected. See Appendices 1, 2, and 3 for the codes used to adhere to the respondents' anonymity throughout the study. No names, roles or data are included without the respondent's prior consent. Furthermore, the researcher also ensured that the interview tapes were stored in a safe place only known to the researcher to ensure the anonymity of the respondents. All tapes were also coded to add to the confidentiality of the respondents. Once the study has been completed and the researcher will keep and store the files for the required number of years upon which the researcher will dispose of the research files in a manner as stated in the Data Protection Act 2003. Finally, the researcher will remain impartial and produce unbiased research.

4.12 Chapter Summary

This chapter explained the theoretical and philosophical underpinnings of this research. The research illustrated an anti-positivist orientation in conjunction with adopting a descriptive research design. The methodology uses a qualitative inquiry to find an answer to the research question. As part of the research design, semi-structured interviews were used as the method of data collection. The chapter also explained the validity and reliability issues relating to this study. It is shown that the study analyses qualitative evidence from three different but equally important sources: campus incubation managers, gatekeepers in IoTs and key government informants. Chapter 5 presents the findings from the research.

Chapter 5: Gatekeepers' Influence on the Technology Transfer Process

Chapter Five **Gatekeepers' influence on technology transfer**

5.1 Introduction

In this chapter, the findings that have been arrived at from the research method employed during this study, semi-structured interviews, are presented. The findings are largely structured around the areas of literature discussed and examined in Chapter 3 and the objectives of the research study. The findings also address the results based on the research method utilised over the course of the study. As the majority of interviewees were male, from here on in, for the purposes of ease and simplicity the gatekeepers will be referred to as he and his. Furthermore, in order to preserve the anonymity of the individual respondents, all identifying information has been removed.

Rice and Matthews (1995) and Duff (1994) were of the opinion that incubation centres and their managers were the primary drivers (i.e. gatekeepers) of technology transfer. However, this research study has demonstrated that the incubation centre managers while considering themselves to be supportive of the process viewed their role more as a facilitator rather than as a gatekeeper of technology transfer. The evidence revealed that the incubator managers considered the facilitation of technology transfer to be their main influence (Manager1). Similarly, the managers considered their role as a facilitator of technology transfer through marketing, creating awareness among other stakeholders and also making sure that the incubation centre was full (Manager2). The incubation managers also believed that the facilitation of technology transfer and fostering a culture of research and innovation throughout the IoT to be their main influence on the process (Manager10). It was also identified that this particular manager was the main go-to person for academic faculty who had an idea for commercialising technology and as a result, believed that he had an impact on the technology transfer process in his IoT.

Based on the findings gathered from incubation managers it became apparent they believed the responsibility for developing the technology transfer process belonged to other dedicated members within their IoTs. In total the six incubation managers identified 23 gatekeepers. The managers also believed that these key individuals were the people to whom the academic community turned to for information on technology transfer.

The objective of this analysis chapter is to provide answers to the research objectives highlighted in Chapter One and ascertain whether or not gatekeepers have an influence on technology transfer. One of the main objectives of this research was to ascertain the gatekeepers' roles in the IoTs. First and foremost the chapter study's the established roles of gatekeepers through analysing their background, education and experience and how this impacts on research activity in their respective IoTs. In order to analyse their full impact in the IoTs the gatekeepers are split into 2 main groups (gatekeepers involved in research centres and gatekeepers not involved in research centres).

It was also an objective of this research to ascertain the effect of gatekeepers' education, experience and networks on technology transfer and also the nature of their influence. In order to answer these objectives each gatekeeper group is examined based on their utilisation of skills gained during their education and experience. Education qualifications such as academic degrees were found to facilitate gatekeepers in the absorption of knowledge and its dissemination throughout the organisation making technology transfer successful (Schmidt, 2005). Furthermore, Bozeman and Feldman (2003) proposed that individuals who had previously worked in organisations that engaged in elements of technology transfer would be better able to engage others in the process, than individuals who were not exposed to technology transfer activities. Oliver and Liebeskind (1998) discovered that networking between gatekeepers and others within and outside the organisation increased the sharing of knowledge (Nonaka, 1998). Therefore, the gatekeepers' utilisation of network contacts to facilitate their role in the technology transfer process is presented along with evidence of their influence on technology transfer.

The next section provides answers to the first objective of this research through exploring the roles, background and education of the 23 gatekeepers interviewed for this study. It must be noted here that although this research is studying the influence of gatekeepers on technology transfer and not the individual performance of each IoTs' technology transfer process it is still important that an overview and background of the gatekeepers located in the IoTs along with the

IoT research expertise. Section 5.2 explores the number of gatekeepers in each IoT and their respective roles.

5.2 Gatekeepers in IoTs

As can be seen from Figure 5.1 the IoTs selected to be part of this study are situated in various locations throughout Ireland. Figure 5.1 also illustrates, IoT10 and IoT3 identified three gatekeepers and IoT1, IoT2 and IoT13 identified five gatekeepers each. IoT6 identified only two gatekeepers.

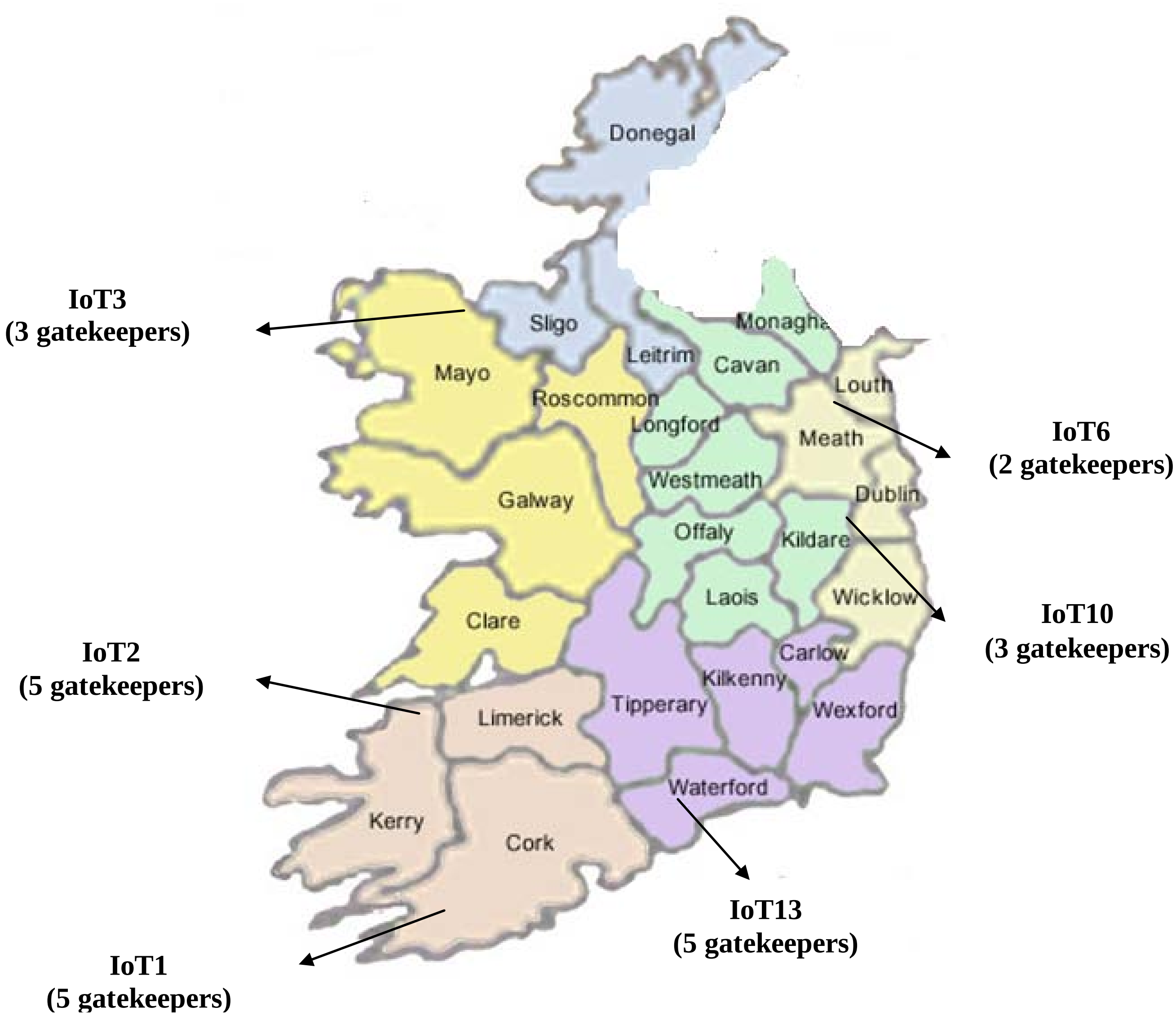

Figure 5.1 Selected IoTs locations in Republic of Ireland (Source: Current research)

Table 5.1 illustrates the roles of each of these gatekeepers. As can be seen from the table, Industry Liaison Managers (ILM) were the most commonly referred to as gatekeepers with five of the six institutes naming their ILM as a gatekeeper of technology transfer. The ILM's main responsibilities are to engage with industry and encourage the collaboration between the IoT and industry sector. Also the ILM supports research and innovation that occurs in the IoT through working with funding agencies and supporting academic researchers in their funding applications.

The Head of Research and Head of ARE (Advanced Research Enhancement Centre) were the next gatekeepers named as influencing the process. The main role of a Head of ARE is to develop technologies stemming from research occurring in the IoT and facilitating the collaboration between the research centre and industry. Some or rather two of the institutes formed new positions in order to concentrate more effectively on transferring technologies from the college, IoT2 and IoT3 created the roles of Head of Research and TT, Head of Graduate Studies and Head of TT and Innovation. Out of the six IoTs interviewed only IoT13 had a dedicated technology transfer officer.

	Head of ARE	Industrial Liaison Manager	Commercialisation Specialist	Head of Research	Programme Manager	TTO	Incububation Manager	Head of Development	Head of Graduate Studies	Head of Research and TT	Head of TT and Innovation
IoT13						×					
IoT13		×									
IoT13					×						
IoT13			×								
IoT13				×							
IoT1	×										
IoT1	×										
IoT1		×									
IoT1			×								
IoT1	×										
IoT2								×			
IoT2		×									
IoT2					×						
IoT2										×	
IoT2									×		
IoT3											×
IoT3				×							
IoT3	×										
IoT6				×							
IoT6		×									
IoT10							×				
IoT10		×									
IoT10	×										

Table 5.1 Gatekeepers roles in IoT (Source: Current Research)

Upon closer examination of Table 5.1 it can be seen that IoT1 identified three Heads of ARE, a recently appointed Commercialisation Manager who was in charge of bringing the IoT technologies to commercialisation and the Industrial Liaison Manager as gatekeepers of the process in the institute. IoT13 identified its Industrial Liaison Manager, its Technology Transfer Officer (TTO) who is responsible for defining the strategy for patenting and licensing in the IoT as well as advising academics about Intellectual property for their technologies. IoT13 also identified the commercialisation manager, the head of research and the programme manager in charge of the enterprise platform programme in the IoT. Similarly IoT10 identified the Industrial Liaison Manager and the Head of the ARE in the institute, the incubation manager also believed he was a gatekeeper of technology transfer and also had the dual role of being programme manager for the institute and ran the enterprise platform programme. IoT6 only had two gatekeepers, its Industrial Liaison Manager and Head of Research. IoT2 had five gatekeepers of technology transfer including its Industrial Liaison Manager, Programme Manager, Head of Development, Head of Graduate Studies and the Head of TT and Research. Lastly IoT3 identified three gatekeepers namely the Head of Research, Head of ARE and the Head of Technology Transfer (TT) and Innovation.

Table 5.2 illustrates the education qualifications and background experiences of the 23 gatekeepers in this research. As can be seen from Table 5.2 ten gatekeepers had a PhD while ten possessed a Postgraduate degree. One gatekeeper had leaving cert qualifications and was in the process of completing his degree. IoT2 had the highest number of gatekeepers with PhDs with three out of five having one; while IoT13 had the highest number of gatekeepers with postgraduate degrees at three. IoT1 was next with its five gatekeepers having two PhDs, two postgraduate degrees and one degree.

	Education			Experience					
	PhD	Masters	Degree	Engineering/ Electronics	International Mkting and Business	Industrial Manufacturing	Science and Software	Academia	Other
IoT13	×					X			
IoT13		×			X				
IoT13		×			X				
IoT13		×					X		
IoT13	×					X			
IoT1	×							X	
IoT1		×		X					
IoT1			×		X				
IoT1		×		X					
IoT1	×			X					
IoT2	×						X		
IoT2		×		X					
IoT2			×				X		
IoT2	×						X		
IoT2	×				X				
IoT3		×							X
IoT3	×						X		
IoT3			×	X					
IoT6	×							X	
IoT6		×			X				
IoT10		×			X				
IoT10	×			X					
IoT10		×					X		

Table 5.2 Gatekeepers education and backgrounds (Source: Current Research)

The ILM in IoT1 also had professional qualifications in accountancy. It is worth noting as well that the majority of gatekeepers' education was in the fields of engineering and science.

Table 5.2 also illustrates the gatekeepers' backgrounds and as can be seen from the table many of the gatekeepers had similar backgrounds and experiences. The majority of gatekeepers had industry backgrounds with experience in electronics/engineering, science and software, international marketing and business and industrial manufacturing. It is interesting to note that only two gatekeepers had academic backgrounds. Upon closer inspection of Table 5.2 it is clear to see that electronics/ engineering (6), international marketing and business (6) and science and software (6) was the most common background experience amongst the 23 gatekeepers in IoTs

IoT13 had five gatekeepers identified by the incubation manager. They had roles such as TTO, ILM, Programme Manager, Commercialisation Specialist and Head of Research. From the table it can be seen that all five gatekeepers had experience in the most common backgrounds. IoT13 was the only IoT to have a TTO and this gatekeeper had a background in industrial manufacturing. IoT1 also possessed five gatekeepers. They had roles such as Head of ARE, ILM and Commercialisation Specialist. It is interesting to note that IoT1 was the only IoT to have three gatekeepers managing ARE centres. Furthermore, IoT1 also had a gatekeeper whose background experience was in academia.

IoT2 also had five gatekeepers. As mentioned in Table 5.1 IoT2 gatekeepers' had roles such as Head of Development, ILM, Programme Manager, Head of Research and Technology Transfer and Head of Graduate Studies. The majority of these gatekeepers had backgrounds in science and software (see Table 5.2) while the remaining two gatekeepers had previously worked in the international business and engineering/electronics sectors. IoT3 had three gatekeepers who had roles such as Head of Technology Transfer and Innovation, Head of Research and Head of ARE. All three gatekeepers had previously worked in different sectors such as engineering/electronics and science and software. IoT1 was the only IoT to have a gatekeeper who had previously worked in the military forces.

IoT6 was the only IoT to have just two gatekeepers. These gatekeepers were an ILM and Head of Research who had previously worked in the academic space and international marketing and business sectors. IoT10 had three gatekeepers whose roles in the IoT were ILM, Head of ARE and Incubation Manager. It is interesting to note that these three gatekeepers possessed experience in the three most common backgrounds i.e. engineering/electronics, science and software and international marketing and business.

It has been established that the most common roles of the 23 gatekeepers were Head of ARE (5) and ILM (5). Upon further investigation into the backgrounds of the gatekeepers who were Heads of ARE it can be seen that three out of the five gatekeepers had previous experience in engineering/electronics which is one of the most common background experiences of all 23 gatekeepers. As mentioned previously, the main role of a Head of ARE is to develop technologies stemming from research occurring in the IoT and facilitate the collaboration between their research centre and industry. The AREs included in this study completed research in the engineering and electronics area therefore; it is no surprise that three of the gatekeepers had previous industry experience in the area.

It is interesting to note that out of the five ILMs in this research, three had experience in international marketing and business while the remaining two gatekeepers had backgrounds in engineering/electronics. As mentioned previously, the main role of the ILM is to engage with industry and encourage collaboration between the IoT and industry sector, therefore, it is not surprising that three ILMs had previous business backgrounds.

These six IoTs each had main areas of research which they considered themselves to be experts in. IoT1 performed technology transfer activity in medical devices, computing software and electronics, while IoT2 researched the areas of engineering and science. IoT3 performed research in computing software and renewable energy, similarly IoT6 performed research in medical devices, electronics and science. IoT10 had the most expertise of all six IoTs and researched the areas of medical devices, computing software, science and electronics. Finally, IoT13 researched the main areas of computing software and engineering. It is interesting to note that the majority of gatekeepers attached to IoTs possessed backgrounds in the areas of research expertise that the IoTs were engaged in. The next section of this chapter analyses the gatekeepers influence on technology transfer.

5.3 Gatekeepers and technology transfer

Technology transfer required individuals to transfer knowledge in order to be successful (Garud and Nayyar, 1994). These individuals according to Allen (1977) can be referred to as gatekeepers. Gatekeepers can influence technology transfer through their ability to be leaders, to be trustworthy and trusted by members of the organisation, provide/facilitate organisational support structures to others in the organisation and have the capacity to gather, absorb and disseminate knowledge in the organisation. Mitchell (2009) agreed that individuals and their ability to transfer knowledge had an impact on technology transfer. Mitchell's study of the effect of people on the number of patents and licenses generated led her to the conclusion that such people could shape the research and innovation culture of an institution. She described these individuals as being members of faculty who teach, lead research groups, chair departments and enforce the policies and strategies for technology transfer. When reviewing the capacities of gatekeepers in this current study it became apparent that each individual gatekeeper did not have all of capacities referred to by Mitchell (2009). In fact each individual gatekeeper was only active in one of Mitchell's characteristics of a key driver of technology transfer.

The researcher realised that the 23 gatekeepers could be divided into two separate core groups based on Mitchell's (2009) definition (see Figure 5.2). These core groups are analysed based on their education qualifications, background experience and network contacts in order to ascertain whether these qualities have an effect on the gatekeepers' influence on technology transfer as was stated by Shane (2000), Bercovitz and Feldman (2003) and Cross and Parker (2004). The core groups are illustrated in Figure 5.2.

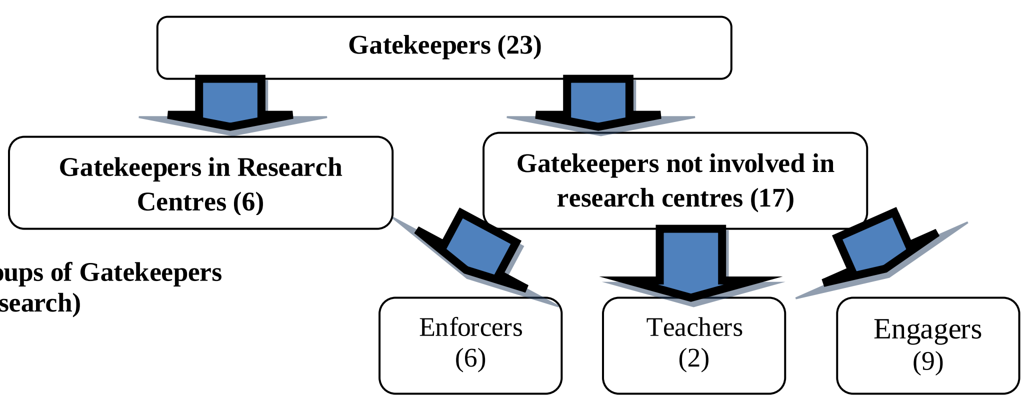

Figure 5.2: Core groups of Gatekeepers
(Source: Current research)

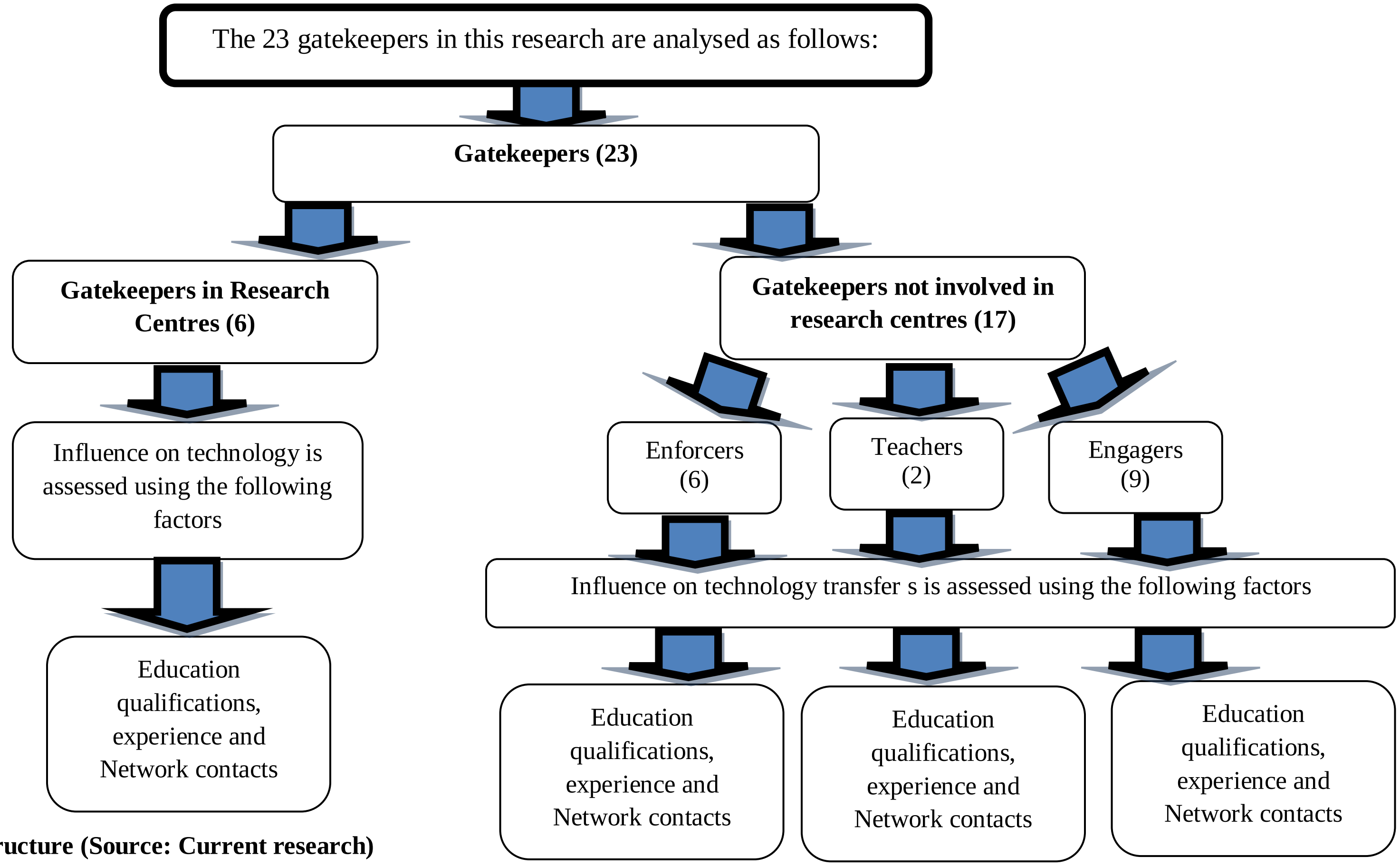

Figure 5.3: Analysis Structure (Source: Current research)

5.4 Gatekeepers in Research Centres

The first group of gatekeepers to be examined are those directly involved with research centres that produce technology in IoTs. The gatekeepers in this group managed the Advanced Research Enhancement (ARE) centres where their responsibilities included producing and managing the technology that was created in the research centres. This was done through collaboration with industry and engagement with technologies that were being transferred by certain members of the academic community. Their consequent influence on technology transfer is examined through the analysis of their education qualifications, experience and network contacts (see Table 5.3).

Gatekeepers	Use Education skills in Role in technology transfer?	Use Background experience in Role in technology transfer?	Use Network contacts in Role in technology transfer?
1-KD1	Yes	Yes	Yes
1-KD2	No	Yes	Yes
1-KD5	No	Yes	Yes
13-KD4	No	Yes	Yes
3-KD3	No	Yes	Yes
10-KD3	Yes	Yes	Yes

Table 5.3 Research Centre Gatekeepers utilisation of skills in education, experience and network contacts (Source: Current Research)

5.4.1 Education

Education can have a positive effect on the absorptive capacity of an individual and increase their ability to disseminate knowledge (Schmidt, 2005). Those with an academic degree are also associated with a propensity to embrace technology transfer (Venkataramen, 1997; Shane, 2000). As can be seen from Table 5.3 two of the six gatekeepers located in research centres utilised skills gained from their education to help them in their role in technology transfer. The roles of these gatekeepers are to encourage the academic community to source ideas for technology innovation, research the technology and transfer it out of the IoT. Some of the gatekeepers felt that their PhD education helped them in providing and facilitating support structures to the academic community through writing reports and most importantly provided the *"knowledge to translate information so that ordinary people could understand"* (10-KD3) and transfer the message out to the general academic population. Other gatekeepers such as 1-KD1 used certain skills gained through his PhD studies to aid him in his role as *"project manager"* in his research centre such as the methodologies employed to produce technologies for commercialisation.

The other four gatekeepers stated that they did not utilise the skills of their education in their role as it merely served as a vehicle to get their position in the research centre however, it did not aid their role in technology transfer. For example the gatekeeper's education did not *"provide enough skills"* (1-KD5) nor did it *"teach the management skill set needed for the role of Head of Advanced Research Enhancement (ARE) Centre"* (1-KD2). However, what the gatekeeper's education did provide was the *"ability to work in teams"* in order to *"manage the creativity and innovation process that occurs in research centres"* (3KD3).

5.4.2 Experience

In contrast, all six gatekeepers, considered the skills gained from their experience to be a significant influence on their role in technology transfer (see Table 5.3). In the case of all six gatekeepers, the role of Head of ARE involved bringing technologies from basic research ideas to commercialisation. Therefore, a certain amount of knowledge is required to be able to understand what industry needs are and translate this information to the academic environment. Bercovitz and Feldman (2003) stated that individuals who had previous experience working in organisations that encouraged participation in technology transfer would continue this practice. This included the ability to work with industry through technology transfer. The six gatekeepers in the research centres all had experience working in the industrial sector where a relationship with academic institutions was encouraged. The most common experience or skill-set that they had was *"the competency to work with industry"* (13-KD4) and also the *"practical experience from working with industry"* (3-KD3) in order to facilitate collaboration projects between industry and IoTs. 1-KD5 used practical experience from working in large organisations to run his centre *"like an organisation through setting objectives and informing new technologies"* and used this experience to produce technologies within a certain timescale that would satisfy industry. The gatekeepers also viewed their experience as a means by which they could be treated like *"a business person and not an academic"* (13-KD4) thereby making it easier for them to transfer their technologies to industry as they "*spoke the same language*" (1-KD5). Hence, they were active in leading by example in the IoTs through showing other academics the benefits of engaging in technology transfer. In summary, the gatekeepers involved in research centres used the skills gained during their background experience to influence the transfer of technology through collaboration with industry. As a result of previously working and engaging with the industrial sector meant that these gatekeepers influenced technology transfer by being viewed as a business person and not an academic whilst also having the competency to maintain the industry-IoT relationship (13-KD4, 3-KD3, 1-KD5).

5.4.3 Network contacts

Similar to their background experience, all six gatekeepers considered the use of a network to be an important asset to their influence on technology transfer. The network contacts of this core group were used for the "*dissemination of knowledge*" (1-KD1) concurring with research by Walter, Lechner and Kellermanns (2007) who stated that individuals gain access to valuable knowledge through social ties with network contacts and disseminate this knowledge within an organisation. Network contacts also allowed the gatekeepers to "*meet new people who were essential to developing new technologies*" (1-KD2). This is consistent with research by Seufort, Von Krogh and Bach (1999) who suggested that networks can be defined as a set of linkages among individuals and are normally a resource of knowledge creation and access to new knowledge. The network contacts of this core set were also used to *"bring new business into the research centres"* (13-KD4) and also to *"gain access to other gatekeepers in a similar position in other institutions"* (3-KD3) through attending meetings and information sessions on technology transfer. The final point is consistent with research by Bongers, den Hertog and Vandeberg (2003) who stated that network contacts gained through academics speaking at conferences created a social network of people with similar interests and skills.

The various network contacts utilised by gatekeepers in the research centres are illustrated in Figure 5.4. Five of the six gatekeepers in this core group considered the government funding agency Enterprise Ireland (EI) and industry contacts to be the most vital contacts in their networks. Technology transfer personnel (internal TT staff) were also considered to be crucial contacts to five of the six gatekeepers.

1-KD1, 1-KD2 and 1-KD5 considered their network contacts to be significant to their influence on technology transfer. 1-KD1 utilised his network to disseminate information and locate the people that were needed to transfer technology from the research centre. This gatekeeper did stress that the centre *"did not have a coherent pipeline or engine of contacts yet"* but that was merely because the centre had only been in existence for five years. He was more focussed on building up the research centre to get more funding and engage with more industry partners to facilitate a more successful technology transfer process therefore, this gatekeeper's network consisted of researchers and representatives from EI and other government funding agencies.

1-KD2 and 1-KD5 relied on the same type of key contacts but also turned to their personal and previous employment contacts to drive technology and build up their centres. 1-KD2's approach to driving the centre, while concentrating on guaranteeing funding, also consisted of talking to people and *"having coffee with the heads of department"*. This gatekeeper stated that companies he had previously worked for, would now come to his research centre *"for advice and to ask questions"* due to his reputation and experience gained from his network contacts. As a result of this gatekeeper's knowledge in his research area, industry were approaching the research centre *"with their ideas and thoughts"* for possible future collaboration on technology transfer projects.

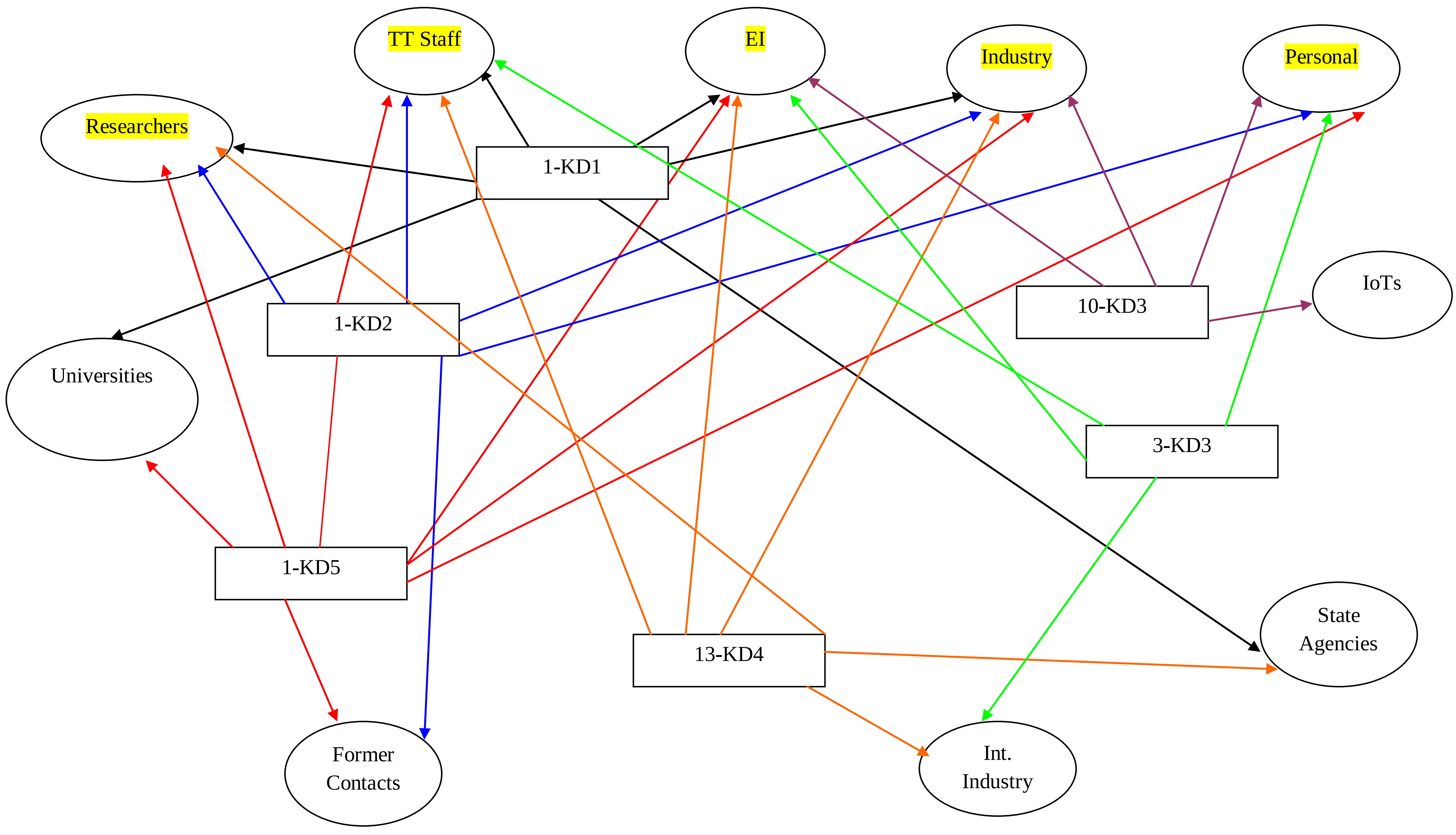

Figure 5.4 Network Contacts of Gatekeepers in Research Centres (Source: Current Research)

Five of the six gatekeepers relied on *"TT staff"* to help increase the amount of technology transfer in the centre while also engaging with people *"who could help in developing the centre"* (1-KD5). Five of the six gatekeepers also considered EI to be a major part of their network to bring business into the research centre and to *"refer business people"* to the centre (13-KD4). The gatekeepers also considered EI *"crucial"* in helping the research centre to make *"contact with businesses in UK, Ireland and San Francisco"* (13-KD4). 3-KD3 also believed that EI was a crucial contact to the network particularly their *"commercialisation specialists"* who assisted the research centre to develop its technology transfer process. This gatekeeper also relied on other gatekeepers such as 3-KD1 and 3-KD2 who also had contacts in EI to assist technology transfer in the IoT. Similarly 10-KD3 considered EI to be a significant *"support contact network"* which assisted the centre to increase their expertise in proposal writing for funding and providing contacts for new business with the industrial sector. He also stated that EI was making *"the transition into EU networks"* easier for the research centre and that this contact was the most important in his network. The next section of this chapter examines the influence of these six gatekeepers on technology transfer.

5.4.4 Gatekeeper's involved in research centres and their influence on technology transfer

This study is examining to what extent gatekeepers influence technology transfer in IoTs. From the evidence discussed above it is apparent that the gatekeepers utilised skills associated with their education and experience in previous employment in their role in technology transfer and believed that they had an influence on technology transfer in their IoT. However, a further question to be asked is whether this translates into any actual influence in the way that technology transfer is developed in IoTs. The research demonstrated that gatekeepers believed their influence existed in their ability to provide and facilitate support structures to the academic community in the form of writing proposals for funding (1-KD1), and the *"enhancement of the research capability of the institute and also producing a return on investment of applied research in the institute"*. The gatekeeper's influence on the research centre involved *"making links with end users and companies"* and to *"build up the client base of the centre in the key sectors it is involved in"* (1-KD5).

Bercovitz and Feldman (2003) found that academics who observed others engaging in technology transfer would consequently engage in the activity and thus gatekeepers would lead by example. Therefore, it can be argued if academics observed gatekeepers engaging in technology transfer then they might also engage. 1-KD1 believed he encouraged academic faculty to engage in technology transfer because he had *"developed all of the policies and structures for technology transfer"* in the IoT and had also helped *"other gatekeepers to develop other aspects of policy related to technology transfer"*. Therefore, by engaging in this activity the gatekeepers believed they were able to lead by example and *"encourage the academic community to engage in technology transfer"* (1-KD1) and *"support the academic community in areas of research that they were involved in"* (13-KD4).

Similarly 1-KD2's influence involved the *"encouragement and development of graduates' skills and the development of technologies from the graduate community"* in the IoT. This influence was also evident because of this gatekeeper's *"ability to talk to graduates about Intellectual Property policy"* and inform them of the benefits of engaging in technology transfer. Other influences that the gatekeepers believed they had on technology transfer were the ability to *"attract companies into the research centre"* (1-KD5), to open up other *"areas of research that the IoT can become experts in"* and develop new technologies as a result of the network contacts that the gatekeepers utilised. 1-KD5's research centre also hired *"3rd and 4th year graduate's"* and taught the benefits of engaging in technology transfer to its students through highlighting the benefits of commercialising research and encouraging students to develop their research into tangible technology. 1-KD5 felt that this had a significant influence on the process as it encouraged other researchers to get involved in the transfer of technology and develop their research for the commercialisation process.

Three out of the six gatekeepers in this group believed their influence was so strong that *"if they were not there, the process would not be in existence"* (1-KD1, 1-KD5, 10-KD3). 13-KD4, the person who set up the actual *"technology transfer office"* in the IoT was responsible for *"overseeing the process"* and making sure that the research centre was achieving its objectives. This gatekeeper believed that this had a significant influence on technology transfer in his IoT as he made sure that the proper support structures were in place such as policy documents for the protection of IP and the successful commercialisation of technology. The gatekeepers also felt they influenced technology transfer in their IoTs through *"talking to academics and trying to link them together to create technology transfer"* (10-KD3) and also *"developing commercial products from the research conducted and bringing them to the marketplace"* (3-KD3). Hence, it can be seen that these gatekeepers strongly believed that they had a significant influence on the technology transfer process in their IoTs and used the skills and experience gained from education and previous experience to maintain that influence. The gatekeepers also believed that their network contacts within the industry sector increased their ability to encourage collaboration amongst the academic community and also in the development of commercial products from the technology produced in the IoT which could be used by the industry sector. This group of gatekeepers also relied on EI as a support base in their role on the technology transfer process where they utilised the funding agency to bring new business into the research centres through the contacts that EI possessed (1-KD1, 1-KD5, 13-KD4, 3-KD3, 10-KD3). These gatekeepers also used their network contacts to gain access to other gatekeepers in a similar position in other IoTs and universities (1-KD2, 13-KD4).

5.5 Gatekeepers who enforce policy and structure

The gatekeepers that were not part of research centres were divided into three further groups (Figure 5.3) that were involved in enforcing, teaching and engaging the academic community in the technology transfer process. This section examines the gatekeepers who enforced policies and structures in the IoTs (Table 5.4). This group of gatekeepers were involved in taking instruction on research development and implementing it in their IoTs.

Gatekeepers	Use Education skills in Role in technology transfer?	Use Background experience skills in Role in technology transfer?	Use Network contacts in Role in technology transfer?
1-KD3	Yes	Yes	Yes
1-KD4	Yes	Yes	Yes
13-KD1	Yes	Yes	Yes
2-KD1	Yes	Yes	Yes
6-KD1	No	No	Yes
3-KD2	Yes	Yes	Yes

Table 5.4 Gatekeepers who enforce policy and structure and their utilisation of skills in education experience and network contacts (Source: Current Research)

5.5.1 Education

Five of the six gatekeepers in this sub-set viewed the skills gained as a result of their education qualifications as being an asset in providing support structures such policy documents for technology transfer within the IoT. In contrast 6-KD1 stated that his PhD qualifications did not provide the skill of *"writing memorandums of understanding or IP polices"* which 6-KD1 used in his role in technology transfer and consequently, spent the majority of his time going to *"other gatekeepers for advice"*. From the findings it became apparent that the gatekeepers used their education to gain trust amongst the academic community which is consistent with previous research that gatekeepers can facilitate trust building amongst colleagues (Allen, 1977). 1-DK4 and 13-KD1 also utilised their PhD qualifications to *"secure a position in the IoT"*. They believed that their degree meant that they were taken *"more seriously by the academic community"* and consequently were referred to for guidance and support. Therefore, while the gatekeepers did not consider their education to have provided them with the skills needed to influence technology transfer in the IoT, education was at least considered partly responsible for gaining the trust of the academic community. 1-KD4 added that an education in intellectual property policy, new product development and new venture creation allowed him to facilitate the provision of support structures to the academic community such as policy documents. 1-KD3 and 3-KD2 used their education to help *"generate new knowledge"* for writing technology transfer policies while also giving them the skills not to be afraid to *"apply for funding and enforce new policies in the IoT"*.

5.5.2 Experience

Skills gained as a result of their experience were also considered to be an important asset by five of the six gatekeepers for enforcing structures in the IoTs. The gatekeepers' experience provided them with skills in *"identifying if a company has commercial potential"* (1-KD3), *"identifying and protecting IP, understanding the legalities for policy formatting in IoT and the skills to assist the commercialisation of start-up companies"* (13-KD1) and skills in "*consultancy and understanding what industry needs are*" (3-KD2). Being able to engage with individuals was another trait that the gatekeepers' experience provided. 1-KD4 stated that it was easier to *"understand how industry people think and act"* because of his experience in the engineering sector. This gatekeeper's experience also meant that he was successful in *"providing and facilitating support structures within the IoT so that technology produced in the IoT could be commercialised"*. 2-KD1's role was to enforce the policies and structures relating to the technology transfer. This gatekeeper used his experience to *"talk to people"* and also to become an *"expert in the technology being transferred"* in the IoT so that he could commercialise it. 6-KD1's academic experience did not provide the skills needed to write memorandums of understanding or IP policy. However, it did provide the skills *"to engage with and be accepted by the academic community in the IoT"*.

5.5.3 Network contacts

Kota and Prescott (2002), in their study of the advantages of networks, concluded that networks carry the benefits of enabling a firm to access information from a diverse set of resources thereby facilitating the dissemination of knowledge in the organisation. All six of the gatekeepers in this sub-set used their diverse set of contacts in their networks, (i.e. EI, industry, TT staff and gatekeepers in other universities and IoTs), in order to enforce policies and structures for technology transfer in the IoTs and disseminate these policies and structures to the academic community. The network contacts were used as *“a tool to gain access to other gatekeepers”* and to gain access to their knowledge (2-KD1). The majority of the gatekeepers networked with other technology transfer staff in their IoTs (6-KD1,2-KD1) while others networked with key government agencies (3-KD2) to aid them in bringing policies and structures for technology transfer into the IoT. Interestingly, the gatekeepers believed that technology transfer staff in their respective IoTs was the most important network contacts as they were all working towards the same outcome i.e. engaging people in technology transfer. Similar to the gatekeepers in research centres the policy enforcers also turned to EI for support however, this sub-set also used other gatekeepers in their IoTs as network contacts. Figure 5.5 illustrates the network contacts of this sub-set of gatekeepers.

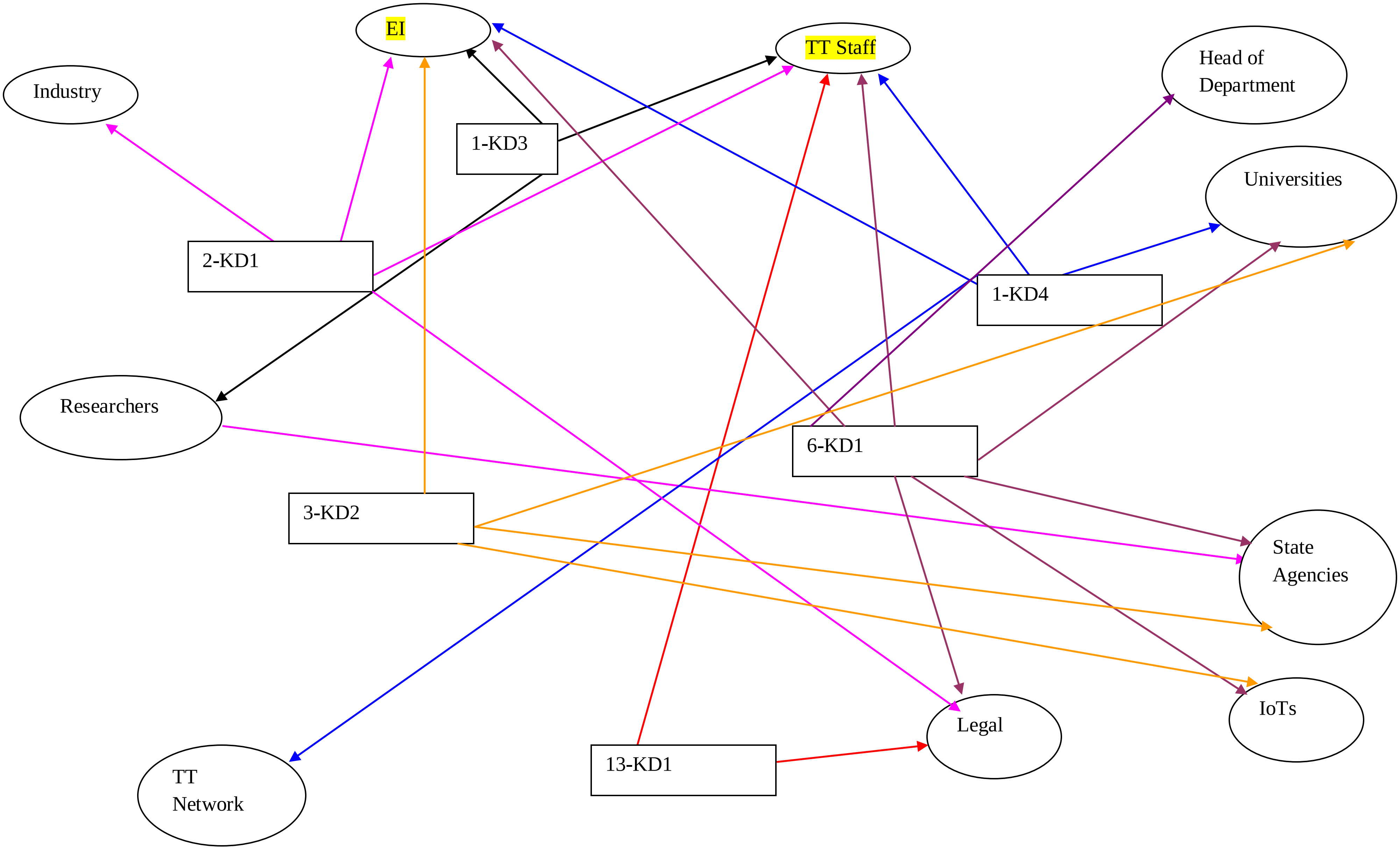

Figure 5.5 Network Contacts of Gatekeepers who Enforce Policies and Structures (Source: Current Research)

As can be seen from Figure 5.5, five of the six gatekeepers considered EI and Internal Technology Transfer Staff to be vital contacts in their network. EI was crucial in helping 1-KD3 *"to execute and enforce technology transfer in the IoT"*. 1-KD4 believed that EI was an important contact in his network as *"they provided funding for the IoT*". 6-KD1 also stated that EI would be one of his key contacts as the agency *"had training courses"* in the different aspects of technology transfer and commercialisation which 6-KD1 attended. However, this gatekeeper stated that the main contacts in his network would probably be *"IoTi research group"* who were quite helpful in certain aspects of his role in enforcing research and technology transfer policies.

Internal Technology Transfer Staff were also important contacts in 1-KD3's network. His role, due to time and resource constraints, did not focus 100% on technology transfer and therefore many of his network contacts for technology transfer were internal to the institute. This gatekeeper stated that 1-KD4 would be the *"key contact"* in his network especially as his role involved dealing with the policies and structures related to technology transfer. 1-KD4's network also consisted of *"people in universities in Ireland and the United Kingdom"* who would have enforced similar types of policies and training in technology transfer. Industry contacts were used *"to get funding deals for research in the institute"* (1-KD4) which helped this gatekeeper to become more knowledgeable in the structures and guidelines for dealing with external funding sources (i.e. EI) for the IoT.

In contrast to the other gatekeepers in this group, 13-KD1 did not have *"a particular network"* that he used for his role in technology transfer. As this gatekeeper's responsibilities could change on a daily basis he did not use the same network contacts on a regular basis. Therefore, the network of people that 13-KD1 dealt with was diverse and constantly changing. He did, however, have a very close network of *"legal people and patent agent firms"*. 13-KD1 regarded 13-KD2 as crucial to his network as *"he knows everybody and is able to find an answer to most queries"*.

In summary, the findings suggest that the networks of the gatekeepers in this sub-set were important in supporting them in their efforts in implementing policies and structures for technology transfer in the IoTs. They used network contacts to access other gatekeepers and how they were implementing their policies while also utilising EI for their training courses in technology transfer protocols and commercialisation. The subsequent section of this chapter analyses the gatekeepers' influence in the IoTs.

5.5.4 Gatekeepers who enforce policy and structure and their influence on technology transfer

All six gatekeepers in this sub-set believed that the dissemination of knowledge was their most important influence thereby concurring with Allen (1977) and Bercovitz and Feldman (2003) on the impact of gatekeepers on technology transfer. 1-KD3's and 1-KD4's roles in the IoT included the *"capture and protection of the knowledge coming out of the institute and transferring it out of the IoT"* which is an essential role in technology transfer. Similar to the gatekeepers in research centres, these gatekeepers also considered their influence to be so strong that if they were not *"there the process would not happen at all"* (1-KD3) and that *"there was a bit more structure"* (1-KD4) in the IoT regarding technology transfer since their arrival. Therefore, the academic community had secure and effective policies which made it easier for them *"to engage in technology transfer and share their knowledge with the industry sector"* (1-KD4). Similarly the gatekeepers believed that because they *"set all the rules and boundaries"*. (6-KD1) relating to technology transfer the IoT relied on them to make the process work efficiently.

Allen (1977) and Tushman and Katz (2002) suggested that gatekeepers translate and facilitate conversations in a technology transfer environment. These traits were displayed by 2-KD1 in his ability to *"support the academic community in the pursuit of knowledge, capturing that knowledge in a systematic way and seeing if there was a way to transfer that knowledge to people who need it"*. In particular, 1-KD4 believed that there *"was a lot more technology transfer activity"* in the IoT that did not exist before his involvement. This gatekeeper also believed that his influence resulted in *"a lot more people engaged in technology transfer"* as the focus in the IoT was now *"more towards commercialisation"*. The influence of the gatekeepers was also demonstrated in their *"encouragement of the production of exploitable IP"* (13-KD1) in the IoT and also in influencing the relationships that developed in the academic community amongst industry personnel resulting in increased technology transfer. In particular the gatekeepers believed that their presence was influential in *"making sure technology that was developed within the institute could be commercially licensed to industry"* (13-KD1) through the development of support documents such as *"IP policy for their IoTs"* (6-KD1). The gatekeepers also considered their influence on technology transfer to resonate in their *"facilitation and support of the process"* (3-KD2, 1-KD1).

The findings from this research show that the gatekeepers considered their existence in the IoT to have a significant impact on technology transfer. They believed that if they did not have a presence in the IoT, technology transfer would not exist. The gatekeepers believed they were becoming an increasingly important part of their institutes' research strategies due to their role in technology transfer. The gatekeepers viewed the structures they had put in place made technology transfer more efficient in their IoTs due to the proper enforcement of policies and structures and made the IoTs more profitable as a result of increased awareness amongst academic faculty towards technology transfer. Furthermore, according to 6-KD1 without his presence in the IoT, IP policy would not get the attention it needed to advance further. It is also apparent that the gatekeepers used the skills from their education and background qualifications to influence the structure and policies of the technology transfer process.

Thus, it is clear from the evidence demonstrated herein that the gatekeepers in this sub-set believe that they have a significant influence technology transfer in the IoTs. The gatekeepers stressed that without their presence in the IoT, policies and structures relating to technology transfer and its progression would not get the attention that they deserved. They believed that they were making the effort to educate themselves on the importance of polices and structures in IP policy and were crucial to the dissemination of this information to the IoT community.

5.6 Gatekeepers who teach

Allen (1977) and Tushman and Katz (1980) described one of the key traits of gatekeepers as the ability to ascertain and retain information from their network contacts and disseminate that knowledge to those they feel require it within the organisation. The sub-set of gatekeepers, whose role involved teaching students in the IoT, displayed this trait and also utilised their education qualifications to engage and inform researchers/students in how to generate ideas and exploit technology transfer in the IoT. Table 5.5 demonstrates that these gatekeepers believed that their education, experience and network contacts helped them to influence technology transfer.

Gatekeepers	Use Education skills in Role in technology transfer?	Use Background experience skills in Role in technology transfer?	Use Network contacts in Role in technology transfer?
2-KD4	Yes	Yes	Yes
2-KD5	Yes	Yes	Yes

Table 5.5 Gatekeepers who Teach and their utilisation of skills in education, experience and network contacts (Source: Current Research)

5.6.1 Education

2-KD4 and 2-KD5 emphasised that their role involved the transfer of knowledge from their departments to students and researchers in their IoT. Educational skills enabled the gatekeepers to *"use life skills to supervise students in research"* (2-KD4) so that they can become experts in their chosen field and transfer technologies that they produce. The skills acquired from education also allowed gatekeepers to *"understand how small companies work and how they innovate"* (2-KD5) as a result of their previous PhD research.

5.6.2 Experience

2-KD4 and 2-KD5 considered their experience to be important to their role in technology transfer. Their experience allowed them to understand students'/researchers' needs, engage with them and ensure that *"students were not afraid to ask for opinions or advice"* when generating ideas for technology transfer (2-KD4). In particular 2-KD4 stressed that by constantly updating his experience through attending courses such as *"enterprise start-up courses"* it made him much more aware of the strengths of technology transfer and how important it was to the IoT, in particular the importance and benefit of academic researchers engaging in technology transfer. This gatekeeper believed that *"identifying the shortcomings in his experience"* helped him to disseminate the appropriate information to students. The identification of shortcomings made the gatekeepers more skilled in supplying students and researchers with knowledge in areas such as technology transfer and its benefits. The gatekeepers also engaged with industry to encourage the transfer of technology between the IoT and industry. In particular, the experience of "*working with and interacting with smaller firms*" (2-KD5) meant that the gatekeepers had knowledge in dealing with industry at all levels and therefore, were more "*aware of what the industrial sector wanted*" (2-KD5).

5.6.3 Network Contacts

Cross, Borgatti and Parker (2002) stated that individuals rely on networks to find information and solve problems. This was demonstrated in the results obtained, as 2-KD4 stated that engaging students in technology transfer was "*something that you could not do alone*" and that "*regular meetings with other members of the technology transfer team*" in the IoT were significant in enhancing their effect and influence on technology transfer engagement amongst academic researchers. The gatekeepers also "*turned to individuals in a similar position to understand and observe what they do*" so that they could better ascertain how technology transfer was perceived in other IoTs and learn from that knowledge. The gatekeepers believed that "*networks were there to help you*" (2-KD4) and that everyone was "*aligned to a network*" (2-KD5) however, it is "*still very much a learning curve*". As can be seen from Figure 5.6 these gatekeepers had a wide network of contacts with technology transfer (TT) staff, universities and other IoTs being the most common contacts in both gatekeepers' networks.

Unlike the gatekeepers who were involved in leading research centres in the IoTs EI was not the main contact used by the gatekeepers who taught with only 2-KD4 viewing the funding agency as vital to his network. 2-KD4 emphasised that although EI was key to the network "*the institute was not really at the level where it was immersed in technology transfer yet*" therefore, EI would not be used as much as in other more developed IoTs. 2-KD4 also "*looked to other IoTs and universities to see how they engaged in the technology transfer process*". This gatekeeper stated that his counterparts in other IoTs were quite helpful and obliging in sharing their experiences of engaging students in technology transfer.

2-KD4 also worked closely with 2-KD5 and "*would not make a decision without 2-KD*5's *input and advice"*. Both gatekeepers also believed that the close relationship between them made their impact on technology transfer more significant as it enabled them to "*bounce ideas off each other"*. 2-KD5 had the same contacts as 2-KD4 however, did turn to his own personal network contacts for his role in the process. 2-KD5 found contacts in other universities and IoTs to be the most helpful. This gatekeeper also used a network of other post graduate managers called Research Alliance where they "*would tap into each other's resources to enhance their effect on the technology transfer process"*.

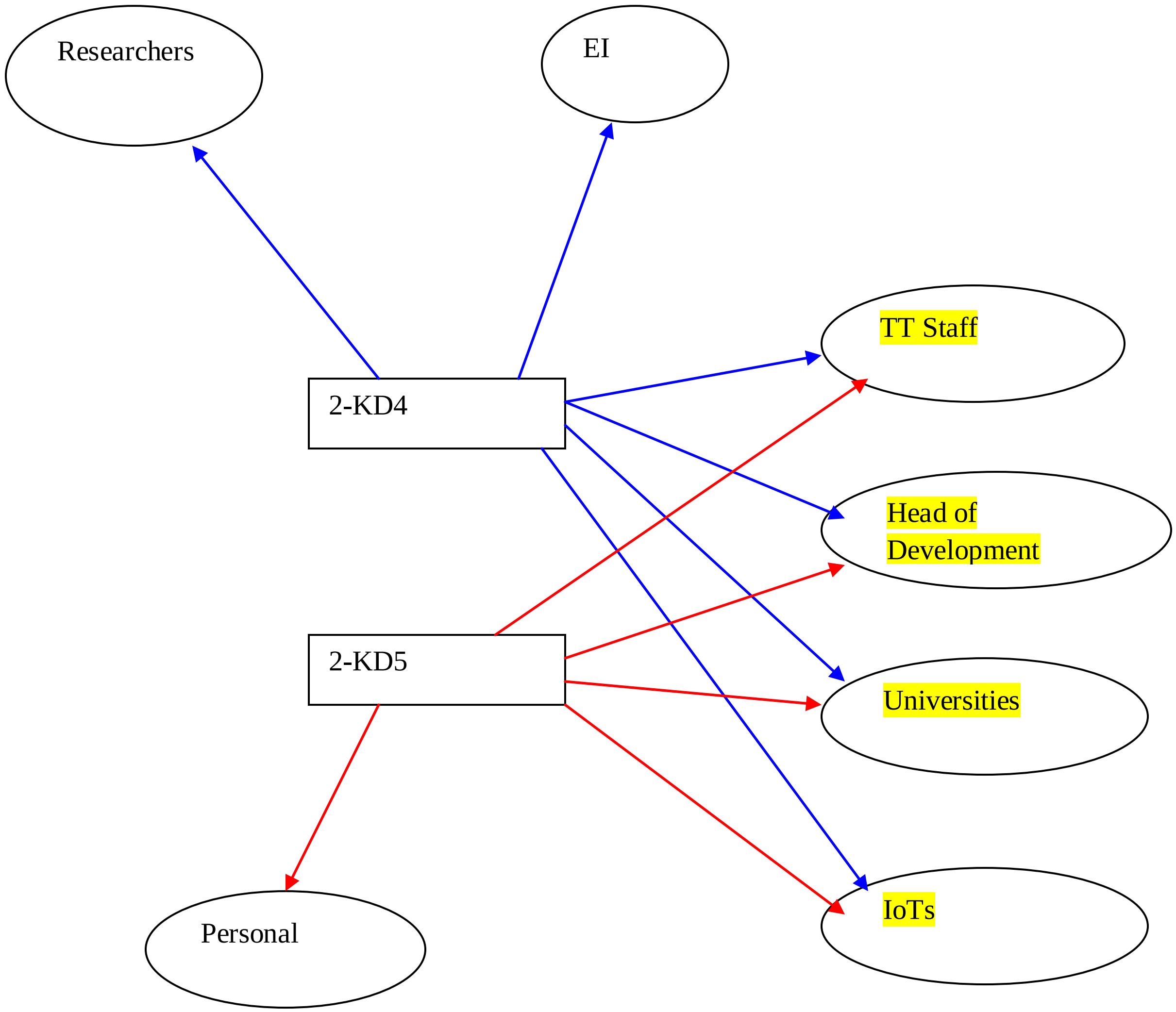

Figure 5.6 Network Contacts of Gatekeepers who Teach (Source: Current Research)

5.6.4 Gatekeeper's who teach and their influence on technology transfer

In contrast to the other gatekeepers, 2-KD4 and 2-KD5 were appointed specifically to work on the development of technology transfer in their IoT. Since their appointment two years ago the gatekeepers had successfully provided support structures to the academic community through *"putting together an IP policy and formalised the non-disclosure agreement in the IoT"* (2-KD4). This gatekeeper believed that he had a significant influence on technology transfer as *"commercialisation was better than it was two years ago"*. Their influence was more evident amongst the academic community as they believed they had *"made researchers more aware of technology transfer"* (2-KD4) and also considered their actual *"presence as important because it automatically made people aware of technology transfer"* (2-KD5). 2-KD5's role was as a mentor and supervisor to the graduate community in the IoT. This gatekeeper believed that *"unless students were pursuing postgraduate degrees they would not be able to unlock potential technologies"* and therefore, believed that he was influential in *"equipping students with the skills to utilise technology and/or create the technology and commercialise it out into industry"*.

2-KD5 also believed that he *"provided the intellectual human side of technology transfer"* as he was educating graduates that could potentially generate new innovation and technology in the IoT. He believed that his influence was in the consolidation of the potential technology and knowledge transfer from graduates. Therefore, the gatekeepers considered their role in the technology transfer process to be particularly important because they encouraged the research community to engage in technology transfer as they used their skills in communication and support of both academia and industry to achieve a stronger technology transfer process within their IoT.

5.7 Gatekeepers who engage the academic community in technology transfer

This sub-set of gatekeepers was responsible for informing and disseminating knowledge to the academic community to become involved in technology transfer. This is similar to the comments put forward by Allen (1977) that gatekeepers were adept at gathering and understanding external information and structuring it into meaningful and useful sets of knowledge. Table 5.6 illustrates the gatekeepers that were part of this sub-set and whether they utilised skills acquired as a result of their education, experience and network contacts.

Gatekeepers	Use Education skills in Role in technology transfer?	Use Background experience skills in Role in technology transfer?	Use Network contacts in Role in technology transfer?
13-KD2	Yes	Yes	Yes
13-KD3	Yes	Yes	Yes
13-KD5	Yes	Yes	Yes
2-KD2	No	No	Yes
2-KD3	No	No	Yes
3-KD1	Yes	Yes	Yes
10-KD1	Yes	Yes	Yes
10-KD2	Yes	Yes	Yes
6-KD2	Yes	Yes	Yes

Table 5.6 Gatekeepers who engage the academic community and their utilisation of skills in education, experience and network contacts (Source: Current Research)

5.7.1 Education

As can be seen from Table 5.6 seven of the nine gatekeepers in this sub-set utilised skills gained during their education in their role in technology transfer. However, for two of these gatekeepers education only *"helped them to get the job in the first place"* (13-KD2). Examples of skills which the gatekeepers' education provided were *"the ability to gather information, analyse this information and decide who to disseminate it to in the IoT"* (13-KD3) and the ability to *"look at things with a different outlook and structure things in a broader perspective"* (13-KD5). Education qualifications also allowed the gatekeepers *"to be accepted by the academic community"* (3-KD1) in the IoT. Education *"provided credibility"* (10-KD1) in the academic environment and *"ability to understand the way that academic's think"* (6-KD2). The gatekeepers' education also provided them with the ability to *"analyse business plans"* (10-KD1) of researchers engaging in technology transfer and *"to put research proposals together for* *funding"* (10-KD2). This gatekeeper's education also provided him with skills in management. In particular the management skill set was beneficial in motivating academics to engage in technology transfer. However, some gatekeepers did not use their education in their role as, to them, it did not provide skills to enable them to motivate and engage IoT academics to transfer technology (2-KD2, 2-KD3).

5.7.2 Experience

The ability to influence technology transfer amongst the academic community as a result of the skills gained from previous experience (Bercovitz and Feldman, 2003) was displayed by this sub-set of gatekeepers. Seven of the nine gatekeepers believed that their experience provided them with the skills necessary to engage the academic community in technology transfer (Table 5.6). For example the skills obtained by 13-KD2 in working in the international business sector meant he was capable of "*communicating with a variety of people"* which resulted in the motivation of these people to engage in technology transfer. Similarly 3-KD1 learned to be aware of the information that was available to him and to decide what knowledge was required by the IoT community in order to *"engage them"* in the transfer of technology. Working with industry was also a vital expertise that the gatekeepers brought to their role. Skills such as being *"industry aware"* while also being *"able to work well with academics"* (6-KD2) were necessary in order to engage the academic community to work with industry and transfer technology.

Knowledge of international markets also guided 13-KD3 in the role of engaging start-up businesses in technology transfer. Through having skills such as "*knowledge of currencies, interest rates, culture dynamics, working in teams and interacting with people"* enabled this gatekeeper to drive technology transfer in the IoT. Leadership was also an important skill set utilised by the gatekeepers. Goh (2002) considered leaders within an organisation to have a major influence on the support structures needed to engage people in knowledge sharing. 13-KD5 had this ability due to experience in *"leading groups in industry"* and formulating the support structures necessary into his department so that it was "*run more like an industry organisation"*. This gatekeeper was therefore, able to introduce the academic community to the culture of the industry sector and therefore, support and motivate them to engage in technology transfer. In contrast both 2-KD2 and 2-KD3 did not utilise experience gained in previous employment in their role. Their role of engaging the academic community in technology transfer involved adopting a completely different set of experiences. Therefore, these gatekeepers had to complete on the job training as the particular skills they required were not acquired from previous employment.

5.7.3 Network contacts

Not surprisingly all nine of the gatekeepers considered their utilisation of network contacts to be an important asset in motivating academics to engage in technology transfer. It was believed that a gatekeeper that was *"not part of a network could not achieve anything significant"* (13-KD5). The gatekeepers were of the opinion that by *"bouncing ideas around with people resulted in a more structured support system"* for members of the academic community in an IoT (13-KD5). Other gatekeepers in this sub-set brought their *"previous employment network"* (3-KD1) with them and relied heavily on those contacts to help engage the academic community in technology transfer. Some gatekeepers also *"talked to others that were better at technology transfer"* (10-KD2) than they were, in order to gain some insight and experience as to how the academic community could be motivated to generate commercial products. Cross and Parker (2004) cited networks as consisting of boundary spanners who communicated with people outside of the organisation and disseminated the necessary knowledge to individuals within their organisation. 6-KD2 displayed the characteristics of a boundary spanner where his network was used to *"link the academic and industry sectors"*. 6-KD2 also believed that the network contacts he had compensated for the lack of time he could commit to engaging academics in the technology transfer process. This gatekeeper was of the opinion that his network provided answers to questions in a much more significant manner then having to do the research himself from the beginning.

Similar to the set of gatekeepers that were part of leading research projects, the gatekeepers responsible for engaging the academic community in technology transfer turned to EI and industry contacts the most. However, similar to the sub-set that taught in the IoTs these gatekeepers also turned to other universities and IoTs to help them in their role. Unlike the other two previous sub-sets of gatekeepers this group also used other state agencies such as HEA and SFI to help them in their role. Figure 5.7 illustrates the network contacts of this sub-set.

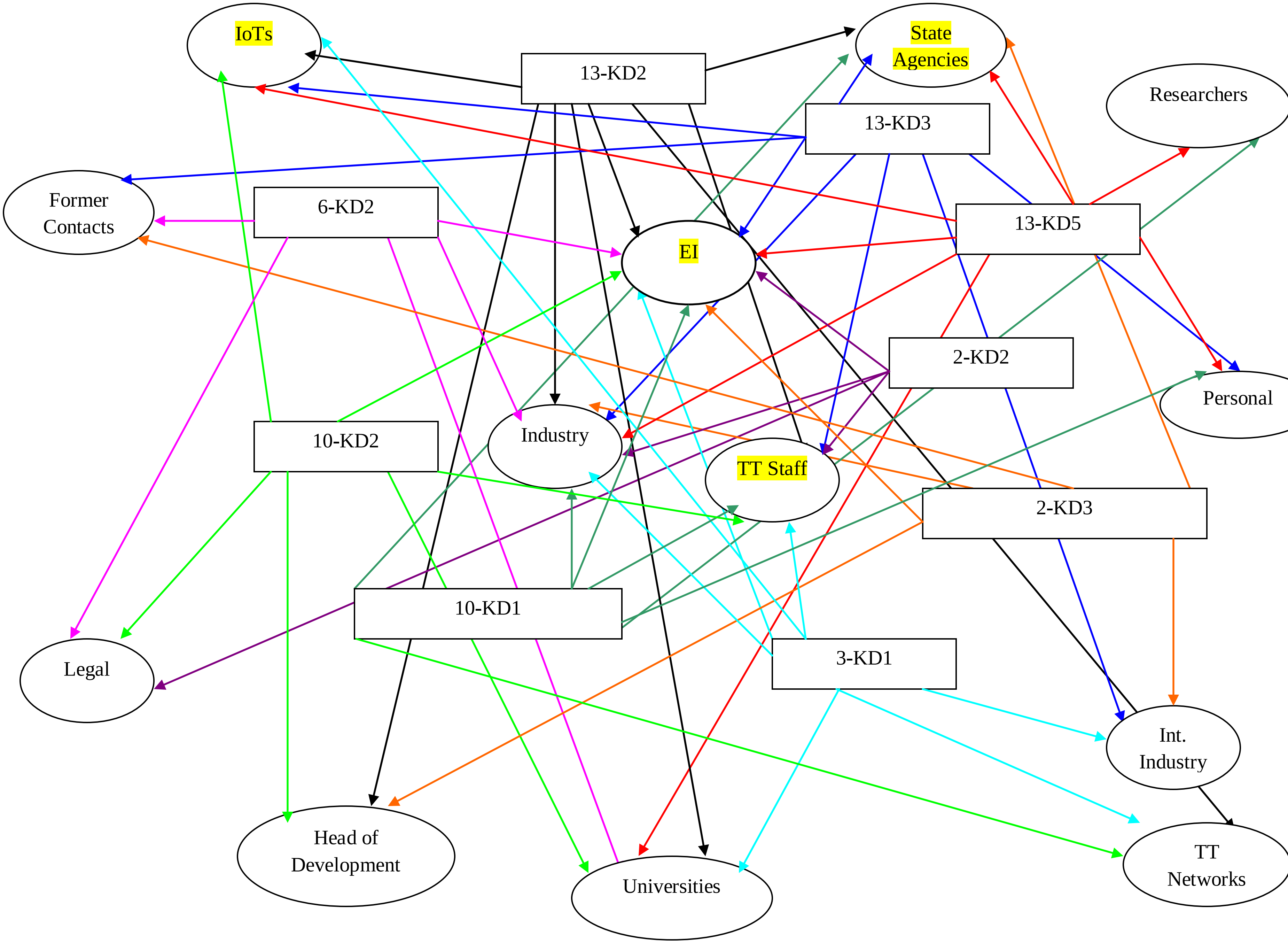

Figure 5.7 Network Contacts of Gatekeepers that Engage the Academic Community in Technology Transfer (Source: Current Research)

As can be seen from Figure 5.7 all nine of the key drivers used EI for support in driving technology transfer in their IoTs. EI was considered *"a key stakeholder"* (13-KD2) as it is *"both a funder and an advisor on research"* (13-KD2). In contrast while citing EI as important to his network, 13-KD3, *"would start with personal networks"* first to try to find the information he required, but 13-KD3 did feel that EI and other state agencies were important in the progression of technology transfer. Some gatekeepers were very *"dependent on EI"* (13-KD5) as a key contact in the network due to the *"commercialisation specialists and specialist expertise in technology transfer"* (3-KD2, 10-KD2) located in the funding agency. EI were also considered a key contact in the gatekeepers' networks as they provided *"help for developing the IoTs IP policy"* (10-KD1), provided *"funding for patenting and invention disclosures"* (10-KD1, 6-KD2) and *"providing training"* for gatekeepers in the institute (10-KD2, 6-KD2).

Five out of nine gatekeepers also utilised network contacts in other state agencies and would *"discuss with them their thoughts around technology transfer"*(10-KD1) and then relay that information back into the technology transfer process. Industry was also identified as an important network contact for eight of the nine gatekeepers. Industry contacts were used by the gatekeepers to tap into a network of industry sources to *"participate in institute technology transfer"* (13-KD2) and to access networks of *"business people who had an interest in business set-ups and had invested in companies before"* (13-KD3). The gatekeepers also *"attended conferences to find out particular industry needs"* (13-KD5) and then communicated this information to researchers in the IoT.

In contrast, 2-KD3 stated that he had a *"huge network"* but no key contacts in that network. This gatekeeper believed that the key to doing his job successfully was *"knowing the right person to do whatever is needed"* and then *"finding those people"*. 6-KD1, 3-KD1 and 10-KD1, in contrast to the other gatekeepers in this group brought their network from their previous employment to their current role in the IoT and remained *"heavily reliant on this personal network"* (6-KD1, 3-KD1, 10-KD1). The gatekeepers believed that their most important contacts were *"counterparts in other universities and IoTs"* (3-KD1) and key people in similar roles so that *"best practice methods could be exchanged"* (10-KD1). Counterparts in universities and IoT were considered important contacts to these gatekeepers in particular. The gatekeepers believed that *"progress could be made in developing the IoTs as more research focused especially in* *technology transfer"* through the use of network contacts in universities in order to learn from them. 10-KD1, in particular, considered 3-KD1 to be a key part of his network as he was *"very active in the support of and finding new invention disclosures and trying to engage research groups to start thinking about commercialisation"*.

As can be seen from the evidence from this research, this sub-set of gatekeepers utilised their network contacts in order to increase the influence they had on technology transfer. Industry contacts were used by this sub-set to maintain their influence on technology transfer through finding out industries' needs and engaging the academic community in collaborating with industry on research projects while EI contacts were used in order to gain access to commercialisation specialists and funding.

5.7.4 Gatekeepers who engage the academic community and their influence on technology transfer

This sub-set of gatekeepers again considered their influence on technology transfer to be so significant that if they were not *"in the IoT, the academic community would not engage in technology transfer"* (10-KD1). This gatekeeper believed that he considerably raised *"the profile of technology transfer activities in the IoT"* while also encouraging the postgraduate community to become involved in technology transfer. This gatekeeper's existence in the IoT influenced the amount of academics that *"got involved in the process"*. The gatekeepers in this sub-set also believed that they had a significant influence as they were directly involved in working with researchers to bring in funding and in setting up *"leading research projects in the IoT"* (13-KD2). This gatekeeper also had a significant effect on the research process as he believed that without his involvement *"there was a chance that the research would not happen in the IoT"*. The gatekeepers also believed that if a team responsible for driving technology transfer did not exist *"knowledge would not get transferred nor would there be any support structures in place to protect IP belonging to the academic community"* (13-KD2). 2-KD3 believed that his influence was so strong that *"technology would not get transferred"* without his presence. 3-KD1 had a significant influence on the process in the IoT and *"brought a very commercial focus to the IoT"* in terms of dealing with the industrial sector. 3-KD1 also brought *"energy and a more business* *and entrepreneurial attitude into the IoT"* which did not exist before. 10-KD2's influence was mainly on driving technology transfer in the IoT and *"inevitably had a big impact on technology transfer as nothing moved without first passing"* through this gatekeeper. He also believed that *"the academic community depended"* on him because he *"processed all the non-disclosure, IP and license agreements"*. Similarly 13-KD5 had a "*style of leadership that influenced technology transfer in the IoT to a great extent"* and had increased the turnover in the IoT. 13-KD5 had an impact in the IoT through *"motivating people while continually leading by example and transferring that experience to other academics and gatekeepers in the IoT"*. He believed that his main advantage to the IoT was through, *"motivating people inside the IoT to become involved in research and technology transfer"*. 6-KD2 believed that since his employment at the institute the *"academic community had become more aware and more commercialised"*. While not claiming to have all the expertise needed to fully drive technology transfer this gatekeeper believed that he had *"made an impact in the IoT"*.

Therefore, based on the findings it is clear that this sub-set of gatekeepers believed that they had a significant influence on technology transfer in IoTs. Their presence alone was deemed to be the main reason why a technology transfer process existed in the first place in the IoTs. It was also found that the gatekeepers believed that the academic community relied on them to provide the relevant support structures such as; policy documents and guides them through the process and disseminates the relevant information that they needed to engage in technology transfer.

Table 5.7 provides a summary of the main points from the analysis of the core groups of gatekeepers in this research. As can be seen from the table the main skills that gatekeepers gained from their education were the ability to be viewed as a credible academic, the ability to understand what industry needs were and the ability to gather, decode and disseminate knowledge amongst the academic community.

Gatekeepers	Education Provided:	Experience Provided:	Network Contacts Provided:	Influence on technology transfer
Research Centre Managers *'producing and managing the technology that was produced in the research centres'*	Credibility Knowledge sharing capabilities	Industry experience. Ability to understand industry. Collaboration possibilities.	Contact with EI. Access to other gatekeepers.	Collaboration with industry. Engagement of the Academic community Knowledge dissemination.
Enforcers *'enforcing, teaching and engaging the academic community in the technology transfer process'*	Write funding proposals. Job in IoT. Credibility.	Commercialisation capabilities. Ability to understand industry. Understand how industries think. Credibility.	Contact with EI. Access to other gatekeepers. Policies and Structures.	Development of new technologies. Support for academic community. Increase awareness of TT in academic community.
Teachers *'teaching students in the IoT'*	Influence Graduates. Ability to understand industry. Credibility	Knowledge dissemination to academic community. Ability to understand industry.	Access to other gatekeepers. Access to other HEIs.	Provision of support structures such as policy documents. Increase awareness of TT in academic community.
Engagers *'informing and disseminating knowledge to the academic community'*	Job in IoT. Knowledge sharing capabilities. Credibility. Ability to understand industry. Write funding proposals.	Industry collaboration. Leadership skills. Communication skills.	Contact with EI. Access to other gatekeepers. Access to other HEIs. Access to more established IoTs.	Increase awareness of TT in academic community. Knowledge/Commercialisation capabilities. Provision of support structures such as policy documents. Engagement of the Academic community.

Table 5.7 Summary of Gatekeepers utilisation of skills gained as a result of education, experience and network contacts and its influence on technology transfer (Source: Current research)

Furthermore, the main skills that gatekeepers experience provided were the ability to understand the way industry thinks, facilitate the collaboration between industry and the IoTs and also the ability to lead and communicate academic faculty to engage in technology transfer activity. In addition, the gatekeepers' utilisation of network contacts facilitated contact with EI and other gatekeepers in other IoTs. Through utilising skills from their education, experience and network contacts the gatekeepers had the unique ability to influence technology transfer by engaging the academic community in the process and also by increasing the awareness of technology transfer in the IoT. Furthermore, these skills enabled the gatekeepers to disseminate relevant knowledge and support structures to the academic community regarding technology transfer policies and procedures which the gatekeepers had developed and facilitate industry collaboration.

5.8 Chapter Summary

The research findings have established that all 23 gatekeepers had an influence on technology transfer in their IoTs and that this influence can be attributed to the education, experience and network contacts that the gatekeepers utilised. It was also found that the gatekeepers in the six IoTs consisted of two separate groups that had certain responsibilities. The first group were involved in research centres in the IoTs and consisted of six gatekeepers. These gatekeepers managed research centres within the IoTs and supported people in research and engaged faculty and the academic community in technology transfer. It was also found that they believed that if they were not involved in the research centres, technology transfer would not occur.

The second group of gatekeepers were divided into three separate sub-sets who were involved in teaching (2), enforcing strategies and policies (6) and engaging the academic community in technology transfer (9). The gatekeepers who taught post graduate students considered their presence to have a significant influence on technology transfer. Their influence extended to maintaining good relationships with the students and making a conscious effort to educate them in the benefits of generating ideas and their commercialisation. These gatekeepers believed that their influence in this area meant they were seen as figure heads for students to talk to if they had an idea for commercialisation, while also introducing students to the world of SMEs and technology transfer and encouraging them to collaborate with industry.

The gatekeepers who strived to engage the academic community in technology transfer considered their experience to be a vital element in their role in the process. These gatekeepers' experiences gave them skills such as leadership, maintaining relationships with both academia and industry and also the ability to put structures in place so that technology transfer processes would exist in their IoTs. The most important skills that this sub-set of gatekeepers considered vital to engaging the academic community were the ability to deal with support agencies and also the writing of funding proposals for technology transfer in IoTs. However, it became apparent that the biggest challenge to these gatekeepers, when trying to influence and drive technology in their IoTs, was being accepted by the academic community. The gatekeepers, particularly 3-KD1 and 10-KD1 believed that having a PhD qualification gave them the credibility to be accepted amongst academic and faculty staff. This, it would seem, made their job of driving technology transfer in their IoTs an easier process.

The gatekeepers who enforced policies relating to technology transfer in the IoTs also believed that they had a positive influence and that without their presence in the institute technology transfer would not get the dedication it deserved. It was also established that the support structures and policies for technology transfer were not in place before these gatekeepers started in their roles. Their roles involved writing policies such as Memorandum of Understandings and influencing the enforcement of the policies in the IoTs.

It was also identified that all 23 of the gatekeepers relied totally on their networks. The two gatekeepers that taught graduate students relied more on other gatekeepers and universities and IoTs in their network to help them influence the process. All nine of the gatekeepers involved in engaging the academic community relied more on key contacts in EI and industry to help them in their role. EI was a key contact of the gatekeepers and the support given by EI was stated to be satisfactory. This is an interesting point as the gatekeepers overall, believed that EI was not providing them with enough support to drive technology transfer in their IoTs. The core set of gatekeepers who enforced the policies and structures within the IoTs also cited EI as important to their network while also liaising with the other gatekeepers in their IoTs to help them to enforce these policies and structures.

The final objective of this research sought to provide answers to the effect of government policies on technology transfer in IoTs. Chapter Six investigates the government influence on the technology transfer from funding agencies such as EI. The chapter also examines the apparent divide that exists between universities and IoTs regarding the allocation of funding from these government funding agencies and how gatekeepers believe the policies enforced by government officials affect their influence on technology transfer in IoTs.

Chapter 6:
Impact of Government Policy on the Technology Transfer Process in IoTs

6.1 Introduction

This chapter provides answers to the final objective of this research study which is to ascertain whether the policies that are implemented by key government officials have any effect on gatekeepers' influence on technology transfer in IoTs. The chapter achieves this through the analysis of key government officials' opinion on the policies that they implement and their belief that the government's method of funding allocation is sufficient and the gatekeepers' apparent dissatisfaction with this method of technology transfer measurement. Section 6.2 examines the impact of policy implementation on technology transfer.

6.2 Impact of Policy Implementation

Successful technology transfer relies on the effective relationship between higher education institutes, industry and government i.e. the Triple Helix Model (Etzkowitz and Leydesdorff, 2000). Smith (2001) believed that the expectations of government funding agencies on higher education institutes to produce results from the funding received had become more intense as national governments were seeking a return on their investment in research and innovation. During the course of interviewing the gatekeepers in IoTs it became apparent that the Irish government also had these expectations from IoTs. From an IoT perspective, the metrics of measuring technology transfer outputs and the treatment of IoTs in comparison to the university sector were viewed as hampering the progression of technology transfer in the institutions. Smith (2001) stated that the use of metrics by government funding agencies to distinguish between the best and poorer performers could result in the poor performers not being allocated research funding by government funding agencies. However, it became apparent that policy was not the only barrier to technology transfer; the IoTs also believed that they were treated differently than universities regarding funding allocation.

6.3 Perceived differences in the defined roles of Universities and Institutes of Technology

As mentioned in Chapter 2, the Irish higher education system is generally described as a binary system (Hazelhorn and Moynihan, 2010). Essentially this means that there are two systems of education in Ireland, of which there are seven universities and 14 IoTs with apparent differences in the way that they are treated in areas such as policy, funding and recognition. In particular the gatekeepers in this study felt that IoTs were treated differently from universities regarding the research funding that was given to them to perform technology transfer activities. 10-KD1 stated that the €10m research quota that was supposed to be raised individually by both universities and IoTs in order to qualify for funding by EI was unachievable by most IoTs as they did not have any help in the form of dedicated technology transfer officers. This gatekeeper could not understand why *"there was no direct support from EI other than commercialisation specialists that were available to all 14 IoTs"* even if there was the capacity to raise the capital required to receive help and funding from the government.

In 2003, the Irish government invited the OECD to undertake a review of the education system to recommend how it could better meet Ireland's strategic needs. In the OECD (2004) report it was stated that IoTs should remain as teaching institutes and committed to relations with SMEs and the regional economy and not institutes that engage in research activity with universities carrying out the major research role in basic research. The OECD believed that Ireland needed a divide between universities and IoTs and that IoTs should not try to become universities. This divide was believed to be needed by the OECD (2004) in helping Ireland to achieve its strategic objectives and that it was essential that their missions were differentiated so that IoTs and universities could concentrate on particular defined functions. Furthermore, it was stated that IoTs be denied access to European research funding except funding from EI (OECD, 2004). The mission of the institutes of technology has been described as *"the commitment to support educational, economic and social and cultural development of the people in the communities they serve"* (IoTi, 2008). So while the IoTs see themselves as research institutes, Gov2 was of the opinion that this depended on how much research was occurring in the institution.

Gov9 was of the opinion that the *"IoTs believe they are on track to becoming a fully fledged university"*. However, it was stressed, by government officials that IoTs have the advantage they can *“react more quickly than universities”* (Gov5, Gov6) which these government officials believed was a distinct advantage for the IoTs. In Gov9’s opinion, like that expressed in the OECD report, IoTs should not be trying to become universities even though the gatekeepers were unsure as to whether *“their role in the knowledge economy is clear enough for them”*. He believed that IoTs should not be treated differently to universities as they possessed advantages over universities that saw their role as collaborating with industry. Gov9 added that IoTs *“cannot be like universities”* as they had different functions and could not learn from universities, a point which 10-KD1 was adamant that the *“current higher education review needed to address”*. This gatekeeper believed that more collaboration was needed between IoTs and universities which would help technology transfer in IoTs in particular. He was of the opinion that more knowledge transfer needed to occur between IoTs and universities.

Gov1 also did not see any difficulty with treating IoTs and universities in a different way. He added that the differentiation was *“not in the label but in the level of research that was occurring”* within the institute. In other words the IoTs are not treated differently because they are IoTs but because they do not generate the same level of capital required for technology transfer funding as the universities. As Gov3 stated *“the IoTs that can show they can deliver the required results will get the support”*. Gov4 had a strong opinion on the funding that was allocated where *“IoTs have research budgets of less than half a million euro”* and are not generating any technology transfer. He added that this *“situation does not happen in universities”* as they have the capacity and the resources to generate technology transfer outputs. Gov2 further stated that EI were providing a certain amount of support for IoTs that were doing a lower level of technology transfer but that they were not providing them with funds to employ a dedicated person to assist them with technology transfer outputs. Gov1 stated that they *“could only consider funding one full time person in technology transfer”* if the institute was generating a suitable amount of research capital.

10-KD1 stated that EI were just concerned with keeping the successful institutions together and leaving the others behind. Gov1 believed that the apparent differentiation between IoTs and universities regarding funding was a *“perceived divide on the IoTs part”*. He added that there would not be a lot that *“the IoTs could learn from the universities anyway”* and that it again comes down to the issue of the time constraints of academics in IoTs and not having enough time to dedicate to technology transfer. This argument by Gov1 supports the opinions of Hazelkorn and Moynihan (2010) that the commercialisation of technology transfer would not be possible for some institutions as their academic community is contractually obliged to teach 16 hours per week which excludes the amount of time they have to prepare lectures, supervise students and correct assignments. This does not leave much time to engage in actual technology transfer research. This is in contrast to the university sector academics that are allocated a certain amount of their weekly hours to perform research as well as their lecturing duties.

Gov10 stated that the IoTs argue they are treated differently yet expect to be guided by the funding agencies. 2-KD5 did feel that the IoTs were disadvantaged as the government decides who gets the funding and who does not. 2-KD5 believed that *"IoTs may not be able to sustain the cycle of idea generation and technology transfer"* that was being demanded from them. However, the advantage that IoTs have is their *"relations with industry"* and many of gatekeepers demonstrated the ability to collaborate, converse with and encourage industry to work with academia (1-KD2, 1-KD1, 6-KD1). As was shown in Chapter 2 universities receive a lot more research funding than the IoTs which is interesting seen as the IoTs are viewed by institutes such as the OECD (2004) as having better industry relations and should be better able to engage in research collaborations with industry partners.

6.4 Policy for technology transfer in Ireland.

It became clear from the interviews with the gatekeepers that the policy for technology transfer in Ireland was not clear and it also appears not to be written down in a comprehensive way (Gov2). The Irish government has only become focussed on returns from commercialisation since 2006, HEIs turned to reports from institutions such as the OECD for guidance. The OECD (2004) report expressed the view that IoTs should not engage in research activity however, this is not the policy that has now been adopted in Ireland where the Irish government has traditionally encouraged all higher education institutes to engage in research and innovation to make Ireland a Smart Economy (Strategy for Science, Technology and Innovation, 2006; Enterprise Ireland, 2008). Therefore, there seemed to be confusion amongst the gatekeepers as to why they were being asked to produce results for patents and licenses required by EI if the OECD stated that they should not be doing it in the first place. The gatekeepers in the IoTs were aware of the old traditional view of IoTs as working with industry and not research institutions. This was emphasised by 10-KD1 who stressed that "*it was not clear from a policy perspective*" why IoTs were made to do more research and compete for funding yet at the same time are being constantly told by groups such as the OECD that they should not be encouraged to engage in technology transfer. Therefore, it is understandable that the gatekeepers find it difficult to encourage the academic community in the IoTs to engage in technology transfer. The gatekeepers in this study believed that the IoTs that were not being funded were performing valuable research and technology transfer which could be of benefit to the economy (3-KD2) however, because it was not research in the priority areas outlined by the government it was not considered worth funding.

Gov2 stated that the policy for technology transfer *"was probably something that was not written down"* but was adamant that it was easily understood by anybody that was connected to technology transfer. However, while 1-KD4 stated he did feel there was a policy, it was more the government telling people that technology transfer is essential for Ireland to become a Smart Economy rather than policy being clear enough to people and motivating them to engage in technology transfer. So while agreeing with Gov1 and Gov2 who indicated that a technology transfer policy did exist in Ireland, the gatekeepers in the IoTs did not agree with the sentiments of Gov1 who stated that this policy had become clearer *"since the publication of the Strategy for Science Technology and Innovation Report in 2006"*. However, Gov1 did admit that there still existed a gap in Irish policy regarding the role of IoTs in the research process. 1-KD2 stated that IoTs were *"very interested in engaging in technology transfer"* but there were still barriers such as measurement metrics and engaging other faculty members in the IoTs to become involved in technology transfer.

In contrast Gov10 stated that there was *"not really"* a technology transfer policy in Ireland. Gov10 disagreed with other key government officials in EI and did not believe that the Strategy for Science Technology and Innovation (2006) report made the policy clearer to IoTs. He argued that there was no clear direction for IoTs as to what their role was in the technology transfer process and that the technologies the government was focusing on did not match the technologies that were being produced by the IoTs, which concurred with the view of all gatekeepers in this study. Therefore, as was iterated by Gov1 there does exist *"a big gap in Irish policy"* thereby agreeing with the sentiments of the IoTs, that there are no clear directions for IoTs regarding their role in technology transfer. Gov8 and Gov9 were of the opinion that there was a policy but *"whether it was any good was another question"*. These key officials did acknowledge that the policy needed to change in Ireland regarding technology transfer protocols, particularly the metrics used by the government funding agencies to measure how successful technology transfer is in higher education institutes. However, according to EI, until another way of measuring research in IoTs is devised the metrics would remain in place.

6.4.1 Government measurement metrics and technology transfer in IoTs

It has been stated by Davenport and Prusak (1998) that measurement and reward systems can play a critical role in encouraging knowledge transfer amongst individuals in an organisation. However, the research findings revealed that the metrics for measuring technology transfer did not encourage technology transfer or mirror the real progress that was being made by the IoTs (10-KD1). The gatekeepers in the IoTs strive to improve their own IoT processes in order to meet the metrics for funding allocation outlined by EI. However, the gatekeepers claimed that they did not have the capital or the resources to do this effectively. The metrics for funding and the distrust of some academic researchers in engaging in technology transfer made the implementation and execution of technology transfer policies in IoTs difficult to enforce.

Key government officials did admit that the need for Ireland to make a return on its investment may have made IoTs try to produce results and gain funding without having the proper support and structure to do so (Gov4, Gov5, Gov10). Key officials did acknowledge technology transfer protocols needed to be amended in Ireland, particularly the metrics used to measure technology transfer in education institutes. The gatekeepers considered the support to the institutions from government agencies to be insufficient in the area of research funding. 6-KD1 was of the opinion that *"the EI mandate was not fair as it is all about metrics"* and although all the IoTs are at different stages in developing their own technology transfer process they are still *"measured using the same metric system"* (6-KD1). 13-KD4 agreed with 6-KD1 in that government does not recognise that IoT start-ups go through different phases and fails to provide adequate "*models to cater for that situation*". 13-KD4 stressed that metrics were dominating the way that IoTs act in research and innovation and were *"driving their behaviour"*. 13-KD4 concluded by saying that EI have a narrow minded view on technology transfer by basing their funding allocations *"purely on metric"* results. This gatekeeper believed that there were many other forms of research and innovation happening in IoTs, clearly not linked to technology transfer processes, but nonetheless was important research.

However, Gov10 stated that EI would never be able to satisfy every IoT's needs. Therefore, this government official expressed that there needed to be a balance of activity in the IoTs and a more holistic approach needed to be put in place. This would involve a more *"collaborative institutional approach to technology transfer metrics"* (Gov10) as the IoTs stress that they are too small individually to engage in technology transfer alone.

Not surprisingly, the key government officials in EI regarded the use of metrics as the most effective way to measure technology transfer. Gov3 stated that the government should reward the best performers in technology transfer and those that are willing and able to make the effort. Furthermore, *"the metrics were set in a realistic fashion"* (Gov10) and that it was up to the IoTs to deliver on those metrics. In other words, the government believed that IoTs need to make more of an effort to transfer technology and start accepting the metrics that were utilised by EI. In contrast to other key government officials, Gov7 stressed that the government did not *"have the metrics right"*. Gov7 was also of the opinion however, that just because the metrics were not right that *"IoTs should not receive any special treatment"* and they should not try and differentiate themselves from universities as regards the metrics that they are measured against.

6.5 Chapter Summary

The research presented external factors that impacted on technology transfer. The gatekeepers believed IoTs were treated differently to the university sector regarding the amount of research funding and support that they received from the government. However, the government, particularly EI, believed the IoTs were not disadvantaged and it was the IoTs' responsibility to drive technology transfer forward in their IoTs and qualify for funding. The metrics used to measure the amount of technology transfer were stated as being unfair by the gatekeepers and should be adjusted to take into account the varying degrees of progress being made by the IoTs. However, not surprisingly, key government officials stated that the metrics were fine and until another way of measuring technology transfer was produced the metrics would not change. The policy that exists for technology transfer in Ireland was also seen as a limiting factor to IoTs. All 23 gatekeepers believed that a comprehensive policy did not exist nor was it obvious to them what their role was in the research process. Some key government officials believed that there was a policy and that it was working well while others believed that there was a gap in the policy for technology transfer and that it needed to be addressed in order for Ireland to become a Smart Economy.

A significant finding of this research was that EI was considered a major contact in 20 of the 23 gatekeepers' networks and provided a crucial support network to them in their respective roles. However, it was still believed that EI was not providing the IoTs with enough support and funding to successfully drive technology transfer. It was established that the gatekeepers in the IoTs were not happy with government support for technology transfer in particular EI support for funding applications for technology transfer. The next chapter will discuss the results of the findings with particular reference to how the gatekeepers influence technology transfer in IoTs.

Chapter 7: Factors associated with gatekeepers' influence on technology transfer

Chapter Seven Factors associated with gatekeepers' influence on technology transfer

7.1 Introduction

The purpose of this chapter is to discuss the findings emanating from Chapters 5 and 6. It was established in Chapter 5 that all 23 gatekeepers interviewed believed that their presence was needed in IoTs so that technology transfer would occur. Therefore, the first section of this chapter investigates whether gatekeepers have any influence on their IoT technology transfer process outputs.

Secondly, the research findings imply that the gatekeepers' believed their influence on technology transfer was as a result of their ability to be leaders in the IoT, to be trusted by the academic community within the IoT, to provide/facilitate support structures to other members of the community, to be collaborators and finally to gather and absorb knowledge and disseminate it throughout the IoT. While the gatekeepers considered the skills gained from their education to influence technology transfer, these skills were mainly viewed as providing the gatekeepers with credibility amongst the academic community. However, in the responses from gatekeepers regarding their skills it could be stated that education afforded them the ability to be capable of executing effective knowledge transfer within the organisation i.e. IoT as depicted by Garud and Nayyar (1994).

Thirdly, the research findings established that all 23 gatekeepers used an extensive network consisting of both industry and government funding agencies. The gatekeepers believed that having a network assisted them in producing support documents and procedures for the academic community. The gatekeepers also believed that without having a network, it would be impossible to have any influence on technology transfer in their IoTs. A surprise finding from this study was that 20 of the 23 gatekeepers' believed that EI was an important contact in their networks. This was surprising, as the research findings also suggested that the gatekeepers were dissatisfied with the help and guidance received from this key government funding agency towards their technology transfer activities.

The fourth and final key finding from this study found that gatekeepers were confused as to the role that IoTs have in the government's new research focus. They believed that they were not receiving the guidance and support necessary in order to commercialise the technologies being produced in the IoTs. Therefore, if this is the belief of gatekeepers of technology transfer in IoTs then it could be stated that EIs mission of gaining from this commercial technology may not be easy to achieve. Section 7.2 discusses the gatekeepers' influence on technology transfer with reference made to the literature in Chapter 3.

7.2 IoT performance and influence of gatekeepers' education, experience and network contacts

This section examines whether the gatekeepers' education, experience and network contacts had any influence on IoT performance. As was stated in Chapter 4, the 6 IoTs selected to be part of this study were chosen based on the results of a number of selection criteria provided by incubation centre managers. Friedman and Silberman (2003) stated that a successful technology transfer process ran from the filing of invention disclosures to the eventual creation of jobs/wealth and start-up companies. Therefore, it could be stated that an IoT's technology transfer performance can be measured on the number of jobs and start-up companies created. This being the case it can be seen from Table 4.7 that all 6 IoTs met this benchmark with IoT1 having the largest number of start-ups at 42 and the creation of 160 jobs. IoT6 had the largest number of jobs created at 500 with 12 start-up companies being formed.

Through the examination of IoT1's gatekeepers, it has been established that between them the five gatekeepers had two PhDs, two Masters and one Degree. They also had backgrounds in engineering, international business and academia. The most used contacts in their networks were EI, industry, internal technology transfer staff, universities and academic researchers. In comparison, IoT6 only had two gatekeepers who had one PhD and one Masters. These gatekeepers had backgrounds in academia and international business similar to IoT1. These gatekeepers relied mainly on EI as their main contact in their networks. The main difference between these two IoTs is the number of gatekeepers working together and the number of network contacts they used in their role in technology transfer engagement. Therefore, it could be stated that the reason IoT1 had the highest performance in the number of start-ups was due to the number of gatekeepers located in the IoT and the extensive network contacts used by gatekeepers in order to influence technology transfer.

However, as mentioned previously, the IoTs received the majority of their funding for technology transfer from EI and this funding is based on the amount of patents, licenses, invention disclosures and start-up companies that the IoTs produced. EI now want to see tangible results for the funding that they have already given to IoTs. Spin-out companies are an example of successful technology transfer output within IoTs that has led to eventual commercialisation of technology. Spin-out companies have been defined as a venture which is given support by another entity (often by a university as part of a technology transfer program) in return for a considerable share in the company (Ledbetter and Zipkin, 2002). Furthermore, Lockett, Wright and Franklin (2002) found that universities successful in technology transfer tended to have greater expertise and networks that could be important in fostering spin-out companies. IoT2, IoT3 and IoT13 were the only IoTs in this research to meet the benchmark for number of spin-out companies.

IoT2 had five gatekeepers who between them had three PhDs, one Masters and one Degree. These gatekeepers had backgrounds in science/software, engineering and international business. The most used contacts in their networks consisted of EI, industry, technology transfer staff, universities, IoTs and other state funding agencies. IoT13 also had five gatekeepers who had two PhDs and three Masters. Their backgrounds were in international business, science/software and industrial manufacturing. The gatekeepers in IoT13 had similar network contacts to IoT2 with EI, industry, technology transfer staff, IoTs and other state funding agencies. In comparison, IoT3 only had three gatekeepers who had one PhD, one Masters and one Degree. These gatekeepers had backgrounds in science/software, engineering and the Army. Despite the number of gatekeepers, the most used network contacts were similar to both IoT2 and IoT13 with EI, industry, technology transfer staff, universities, IoTs and international industry. Therefore, it can be seen that the only major difference between these three IoTs is the number of gatekeepers that they have with IoT3 having the lowest number. The IoT gatekeepers had strong network contacts with industry and technology transfer staff in their IoTs which could be a contributing factor to the reason why their IoT was successful in facilitating and supporting the creation of spin-out companies.

Therefore, while it is noted that all six IoTs generated start-up companies and jobs which was stated by Friedman and Silberman (2003) to be the result of a successful technology transfer process, it was seen from this study that the measure of real IoT performance was in the generation of spin-out companies as stated by Lockett, Wright and Franklin (2002). Three of the six IoTs matched this benchmark and although it was seen that their gatekeepers had similar education, experience and network contacts it was not any different to that of the gatekeepers in the other IoTs (IoT1, IoT6 and IoT10). Therefore, it could be stated that gatekeepers had no real influence on the number of start-up, spin-outs and jobs created in the IoTs. The gatekeepers' real influence on technology transfer in their IoTs was not in their performance regarding patent and licensing production but their performance in knowledge creation and dissemination to encourage the academic community to engage in technology transfer and file of invention disclosures. The next section of this chapter discusses the main influences that gatekeepers had on technology transfer in their IoTs.

7.3 Gatekeepers do influence technology transfer engagement

It was seen in Chapter 5 that all 23 gatekeepers believed they influenced technology transfer in their IoTs through their ability to lead research centres, collaborate with industry contacts, absorb knowledge, disseminate it to the academic community and gain their trust. The gatekeepers also stated they influenced technology transfer in their ability to provide support documents on technology transfer policy such as IP and commercialisation processes. This evidence supports what has been discussed in the previous section that the gatekeepers were influential in knowledge creation and academic engagement in IoTs but did not have a direct affect on the number of invention disclosures and patents filed to the Technology Transfer Office (TTO).

Influence	Extent of gatekeepers influence
Trust	Encourage academic engagement with industry Exploit technology in the IoT Gain access to other gatekeepers Credibility amongst academic community and industry Collaboration with industry
Leadership	Develop linkages with industry, Develop linkages in IoT departments Protecting knowledge Development of a research centre Protecting IP and commercialising it Facilitate a Return in Investment Encouraging academics to become involved in technology transfer Enhance research capability of the IoT Transferring knowledge out of the IoT in a useable form Putting together a research team to develop technology Disseminate and transfer knowledge Developing IoT policies
Absorptive Capacity	Development of IP policy Capturing academic knowledge Overseeing the management of research centres, Liaise with enterprise support agencies Drafting of IP documents and policy Management of the generation of knowledge Market research

Table 7.1 Gatekeepers Influence on technology transfer (Source: Current research)

Table 7.1 illustrates the gatekeepers' main influences on technology transfer engagement within their IoTs. The gatekeepers believed that there was a lot more structure in the IoTs' technology transfer activities as a result of their presence and that they influenced the academic community's engagement in technology transfer as a result of their skills in educating and motivating faculty to become involved. Cross and Parker (2004), in their study into individuals and their networks in an organisation, stated that individual's influence exists in their ability to translate information into meaningful knowledge and build trust amongst the community. From a technology transfer aspect, its success relies on the transfer of knowledge and the ability of certain individuals to disseminate this information (Allen, 1977; Daghfous, 2004). Therefore, an organisation needs to have a culture that supports employee knowledge transfer (Goh, 2002) which is assisted by gatekeepers that possess certain capacities to enable the transfer of knowledge (Allen, 1977).

However, upon further analysis the results showed that the gatekeepers' main capacities were facilitating trust amongst the academic community through being viewed as a credible academic as a result of their education qualifications. Secondly, the gatekeepers' influence was evident in their ability to be leaders within the IoT regarding technology transfer. The research findings illustrated gatekeepers' leadership qualities through their ability to enforce policy and structure in technology transfer and also in their ability to understand industry needs and articulate these needs to research centres in the IoTs. Furthermore, the gatekeepers influence was shown in their absorptive capacity abilities. This was evident in the gatekeepers' ability to gather and absorb information from network contacts and disseminate it amongst the academic community in the IoT. The last is consistent with research by Allen (1977) and Cross and Parker (2004).

Hong-Park (2006) stated that if an individual is successful in gaining the trust of colleagues in an organisation then they will be successful in motivating others to engage in an organisation's activities. The research findings showed the gatekeepers believed their greatest influence was engaging and leading the academic community in technology transfer activities while also possessing the capacity to provide the academic community with relevant information in order to understand and collaborate with industry (Table 7.1). The gatekeepers gained this influence as a result of skills acquired from education and previous experience such as working with start-up companies and understanding their needs and articulating it to the academic community.

Furthermore, the gatekeepers gained management experience from previous employment which allowed them to manage research centres in the IoT and run them like industry organisations through setting objectives and targets. This enabled the IoT research centres to work on the same timeline as industry and manage effective industry-academia collaboration projects.

Gambetta (1998) stated that trust in an individual enabled collaborative behaviour amongst the academic community with Goh (2002) proposing that, in order for knowledge transfer to be effective in an organisation, it requires a culture that supports the trust of other members of the organisation so that new knowledge can be shared. The research findings also highlighted that the gatekeepers considered their influence to be so strong in the IoTs because they were successful in gaining the trust of the academic community by being viewed as a credible academic. The gatekeepers were also influential in encouraging academic faculty to pursue new knowledge and use it in a systematic way through educating them in the benefits of engaging in technology transfer and providing the much needed support structures to the academic community for them to engage in technology transfer such as policy and procedure documents to make the process easier to understand. The research data also revealed that gatekeepers highlighted their ability to encourage and increase collaboration with the industry sector to be one of their most significant influence on technology transfer in their IoTs. Several of the gatekeepers believed that by gaining the trust of the academic community within an IoT, a degree of collaboration was being encouraged and technology transfer was seen as a viable activity (6-KD4, 10-KD2, 3-KD1, 6-KD2). Miles and Snow (1992) also stated that trust enabled the promotion of adaptive organisational forms such as networking. This was highlighted in the results, in particular, with 2-KD1 and 6-KD1 as they believed that trust facilitated networking as a tool to gain access to other gatekeepers and their inherent knowledge. The gatekeepers also considered their networks to be a very important instrument to increase trust amongst the academic community to engage in technology transfer.

Cohen and Levinthal (1990), in research into the absorptive capacity of individuals, also stated that an organisation required individuals so that knowledge could be gathered, absorbed and disseminated to other members of an organisation. The absorptive capacity of gatekeepers in this study and its resulting influence was illustrated in the belief that their ability to absorb knowledge and provide/facilitate support structures , such as policy documents, and disseminate it to the academic community and students in the IoT was a significant influence on technology transfer engagement (Table 7.1). This influence was evident from the research findings as the skills acquired by the gatekeepers resulted in gatekeepers being able to understand and identify IP, its legal implications and the ability to consult the academic community on how technology transfer can benefit them and their research.

The gatekeepers' absorptive capacity was also viewed as vital in supporting the academic community in the pursuit of knowledge and disseminating it through their network contacts. This influence was evident from the research findings as the gatekeepers used skills from their education to inform students of the benefits of sharing their knowledge and commercialising their research. Furthermore, the skills gained through previous experience enabled gatekeepers to become experts in technology transfer activity and use these skills to support the academic community and encourage them to engage in technology transfer and increase the technology being transferred in the IoT.

Bercovitz and Feldman (2003) proposed that academics who observed others engaging in technology transfer would also start to engage and therefore, these individuals would lead by example. Confirmation of the gatekeepers' ability to be leaders in their IoTs was evident from the research findings as several of the gatekeepers believed that they had developed all the policies and support structures for technology transfer (1-KD1, 2-KD1, 1-KD3) and that by the academic community observing their work on technology transfer, they had succeeded in leading by example by showing that technology transfer had many benefits. The gatekeepers also influenced technology transfer by motivating and encouraging academics to engage in the process (Table 7.1). This was achieved through teaching post graduate students what the process entailed and encouraging them to turn their research into tangible technology transfer outputs.

Kotter (1990) suggested that individuals with the ability to be leaders in an organisation can have a major influence on its culture and support structures. This study's research findings showed evidence of the gatekeepers' leadership qualities in the IoTs where some of the gatekeepers were solely responsible for leading and managing the writing and publishing of support structures such as policy documents and technology transfer procedures in the IoT. The gatekeepers also showed their leadership qualities in their ability to ensure the academic community and students understood how the process worked and were more inclined to engage in technology transfer.

Similarly, Kotter (1990) stated that the alignment of and motivating people to overcome barriers were elements of successful leadership in an organisation. The research findings established that the gatekeepers believed their influence to be so strong in the IoT that it supported the academic community in their pursuit of knowledge and as a result of this influence technology transfer had increased in IoTs. The gatekeepers' leadership abilities were also displayed in their successful management of research projects in IoTs and their management of the research being produced in the research centres. The gatekeepers believed that their management experience in working with larger organisations helped the IoT to produce technology that industry wanted. The gatekeepers' ability to communicate with both the industry and academic sectors enabled them to facilitate collaboration and encourage academic faculty to engage in technology transfer.

Therefore, the belief of the gatekeepers that without their presence in IoTs, technology transfer understanding and engagement would not be successful may hold true as the research findings have highlighted that the gatekeepers were successful in providing the necessary organisational support structures to facilitate academic participation in technology transfer. The gatekeepers' presence in IoTs has been highlighted as a vital asset in demonstrating that technology transfer was a viable activity and encouraging academic communities' engagement in technology transfer and the TTO.

The research findings also revealed that the gatekeepers believed their experience provided the capabilities to influence technology transfer and that education qualifications merely provided them with the ability to gain credibility and trust amongst the academic community and a job in the IoT. However, this researcher observed through the study's findings that education provided more than credibility; it also provided gatekeepers with the ability and the unique individual characteristics for effective knowledge transfer.

7.4 Gatekeepers' education as an influencing factor in technology transfer in IoTs

Schmidt (2005) stated that education can have a positive effect on the absorptive capacity of an individual and can increase their ability to disseminate knowledge. Venkataramen (1997) and Shane (2000) also expressed that individuals who had academic degrees were more likely to embrace technology transfer. Based on the literature, it would therefore, be reasonable to expect that the gatekeepers' use of skills acquired during their education would be a vital influence on technology transfer in IoTs.

However, in contrast to the opinions of Venkataramen (1997) and Shane (2000), the research findings suggested that gatekeepers believed skills acquired as a result of their experience, as opposed to their education, provided the majority of their knowledge transfer capabilities. Nine of the 23 gatekeepers in this research believed their post graduate degree merely provided them with the credibility to be accepted amongst academic communities and simply made it possible to get the job in the IoT in the first place. The gatekeepers believed that previous experience was their main influence on technology transfer as it provided them with industry knowledge and most importantly, network contacts.

However, upon further analysis of responses from all 23 gatekeepers, it was discovered that the skills acquired by gatekeepers as a result of their education actually provided capabilities that they were attributing mostly to their experience. The findings indicated that education meant that the gatekeepers had the ability to be leaders, gain the trust of the academic community and the capacity to gather, absorb and disseminate knowledge to the academic community in the IoT who needed it. Therefore, it could be stated, based on the results from the research analysis that the findings do in fact concur with Venkataramen (1997), Shane (2000) and Schmidt (2005) that gatekeepers' education can influence technology transfer.

7.4.1 Gatekeepers' education as an influencing factor in their ability to be leaders within IoT technology transfer

The alignment of people, influencing the creation of teams and motivating and inspiring people to overcome barriers are elements of successful leadership in an organisational setting (Kotter, 1990). From an academic organisation's perspective, active, informal and formal interaction between university researchers and companies is also needed for leadership to be effective (Nikulainen, 2007). Further analysis of the research data discovered that the skills acquired from gatekeeper's education assisted them in the inspiration of academics to become involved in technology transfer. This was achieved through writing reports to provide academics with the knowledge to understand the process of technology transfer. The gatekeepers believed that their ability to provide simple explanations and procedures for the technology transfer process would result in more academics engaging in technology transfer. The research data also revealed that educational skills provided gatekeepers with credibility which increased the interaction between themselves and the academic community. The gatekeepers found that having a PhD/Masters degree resulted in academic faculty coming to them for advice and trusting and sharing their knowledge. Also, it resulted in academics coming to them for guidance in getting involved in technology transfer.

By being viewed as a credible academic, the gatekeepers found it easier to engage the academic community with the industry sector and thereby increase the amount of technology transfer between the two entities. Evidence of this increased activity was shown in particular by 1-KD2 as he found that industry were coming to his centre to collaborate on research projects more often while students were also applying to pursue PhD qualifications within his research centre.

Bercovitz and Feldman (2003) and Maak and Pless (2006) stated that leadership skills were vital in sustaining participation in the technology transfer process and also in leading teams so that a shared vision could be achieved. The research data also revealed that gatekeepers' education provided them with skills in managing the creativity and innovation processes that occur in research centres so that the technology stemming from these centres could be utilised in a more efficient way. The collaboration between industry and IoTs is also vital in creating new opportunities for technology transfer (Poyago-Theotoky, Beath and Siegal, 2002). The research findings revealed that skills obtained during the gatekeepers' education provided them with the ability to engage with industry, establish how they work and what they require and transfer this information to the academic community so that successful collaboration possibilities could occur. These skills also enabled gatekeepers to inform industry about the technologies being produced in the IoTs and how they could benefit the sector. In particular, 10-KD3 viewed his influence on technology transfer to be in his ability to establish technologies that were being produced in the IoT across all departments and then ascertain how these technologies could benefit industry. 10-KD3 believed that his key influence on technology transfer was in his ability to facilitate collaboration discussions between his IoT and industry.

Feller, Madden, Kaltreider, Moore and Sims (1987) emphasised that successful technology transfer relied on the actual transfer of knowledge from one person to another. The research findings revealed that the skills acquired during the gatekeepers' education provided them with the capabilities to gather, disseminate, and analyse knowledge and decide who to disseminate it to in the IoT. This is evident from the research as gatekeepers such as 13-KD2, 13-KD4 and 3-KD1 used these skills to liaise with government funding agencies to establish the funding requirements for IoTs and share this knowledge with the academic community. Furthermore, the gatekeepers believed that these skills also resulted in more faculties sharing their research ideas with them and seeking advice on how to commercialise technology. This displays the unique ability of gatekeepers to be leaders in the IoT and to gather all this knowledge and disseminate it to members of the academic community that require it which in turn increases the probability of a successful technology transfer process in their IoT.

However, in order to successfully lead the academic community in IoTs, the gatekeepers also require their trust so that academics will follow their lead and engage in technology transfer. Trust was seen as vital to the gatekeepers as without the trust of the academic community, it would be difficult to encourage them to engage in technology transfer.

7.4.2 Gatekeepers' education as an influencing factor in their ability to be trusted by academic community within IoTs

Venkataramen (1997) and Shane (2000) emphasised that an individual's education made them more aware and open to engaging and discovering new innovative ideas and subsequently more credible and trustworthy with Gambetta (1998) stating that trust enabled collaborative behaviour. This was evident from the research findings as it was revealed that the skills acquired by gatekeepers in their education provided capabilities in generating new knowledge which encouraged academics to trust gatekeepers and work together in sharing knowledge and engage in technology transfer. This new knowledge was obtained from gatekeepers educating themselves in IP policy (6-KD1) and using this knowledge to educate academic faculty on the process of protecting their IP before sharing it with the outside world. Furthermore, gatekeepers such as 1-KD4 used education skills in new venture creation and product development in order to understand the process and transfer these skills to the academic community. This therefore, facilitated trust building between gatekeepers and faculty as gatekeepers were able to answer any queries that academics would have on technology transfer.

As mentioned previously, Venkataramen (1997) and Shane (2000) were of the opinion that education makes individuals more open to engaging with others to discover new innovative ideas. It became evident from this research that skills gained during the gatekeeper's education was a vital asset in trusting and collaborating with each other. The research data revealed that the gatekeepers often turned to their counterparts in other IoTs to share information and learn from other IoTs' technology transfer procedures. The gatekeepers revealed that they often contacted gatekeepers in other IoTs to inquire about their process or to ask for help in producing and facilitating the dissemination of organisational policies or support structures (6-KD1, 2-KD4, 2-KD5, 3-KD1, 13-KD2).

Hong-Park (2006) stated that trust can be increased amongst individuals when people combine and exchange their knowledge. While gatekeepers also have the ability to facilitate trust amongst their counterparts and that through observing [gatekeepers] engaging in technology transfer (Duflo and Saez, 2000; Sorensen, 2001) the academic community would trust [gatekeepers] and follow their lead. In particular these gatekeepers stated that trust between each other was a major part of their influence on technology transfer in their IoTs. The research revealed that IoT gatekeepers, particularly the Industry Liaison Manager (ILMs) and Heads of Research had formed a network amongst each other to discuss their IoTs progress and how they could improve technology transfer in their IoTs.

Sanchez and Tejedor (1995) indicated that industry relate their relationship with higher education to be difficult due to the distrust between the two parties. Other studies have suggested that the main role of gatekeepers is that of reducing the communication gap between the producers and users of knowledge (Daghfous, 2004) thereby, increasing the amount of technology that is transferred. Knowledge transfer between industry and academia is one of the main forms of technology transfer which is often hampered by the differing cultures between the two parties. The research findings revealed that gatekeepers' education provided the skills necessary to obtain the trust of both the academic community (producers of knowledge) and industry (users of knowledge). By having industry backgrounds, the gatekeepers obtained the trust of the industry sector by also being accepted as a business professional. The gatekeepers believed that maintaining contact with industry leaders and facilitating collaboration projects with the IoT was due to their skills in finance (1-KD3) and their ability to explain licensing and patenting agreements between industry and IoTs (13-KD2). Furthermore, the gatekeepers believed education provided credibility within academic circles and encouraging post graduate students to think about sharing their knowledge with industry and commercialise their research (2-KD4). Therefore, it could be stated that gatekeepers' educational skills transcended the cultural barrier and distrust that sometimes exists between academia and industry as they had the capability to be viewed both as a credible academic and a business professional.

7.4.3 Gatekeepers' education as an influencing factor in their ability to absorb and disseminate knowledge within the IoT

Cohen and Levinthal (1990) stated that the ability of gatekeepers to seek information from outside sources such as industry contacts displayed unique absorptive capacity skills. Education, unknown to the gatekeepers, actually impacted on their influence on technology transfer engagement by providing skills in absorbing knowledge and disseminating it to the academic community. Academic degrees also provided gatekeepers with the ability to collate information and translate it into meaningful knowledge (i.e. absorptive capacity). This finding concurs with Cohen and Levinthal (1990) who indicated that absorptive capacity is path dependent as prior knowledge, through an academic degree, facilitates the use of new knowledge thereby increasing the amount of absorptive capacity.

Zahra and George (2002) identified four dimensions of absorptive capacity which were acquisition, assimilation, transformation and exploitation. Upon further analysis of the skills gatekeepers received from their education it was revealed that their qualifications did in fact contribute to their impact on the various dimensions of absorptive capacity. The evidence revealed that gatekeepers had the skills necessary to identify and acquire the knowledge that was required by the academic community. This knowledge was obtained from sources such as counterparts in their own IoT, other IoTs and their industry contacts. In particular, it was found that gatekeepers acquired knowledge from gatekeepers in IoTs who were more successful at engaging the academic community in technology transfer (6-KD2, 2-KD4) and used this information to communicate with faculty in their own IoTs.

It was also found that the gatekeepers' skills enabled them to assimilate knowledge and disseminate it to the academic community in the form of IoT support documents and IP procedures so that they would be able to understand technology transfer. The gatekeepers used skills gained in their education to gather relevant information on the policy support documents and procedures provided by the IoT and other relevant documents needed to educate the academic community on the benefits and ease of participating in technology transfer. The gatekeepers used their skills to learn from this information and generate new knowledge which the academic community would be able to understand and implement effectively (3-KD2).

The ability to transform information was also shown by gatekeepers in their capacity to gather and examine information from a broader perspective and delete any irrelevant knowledge. In this way the academic community was only receiving information which would make it easier to understand and participate in technology transfer. The skills acquired by gatekeepers from their education were valuable in transforming complicated policy documents written and supplied by both the IoT and government into readable step-by-step processes (3-KD2, 6-KD1). Furthermore, these skills also provided the gatekeepers with the ability to exploit knowledge by educating themselves so that they could also write reports, procedures and policies for IP in order to provide the academic community with the most relevant information on how to engage in technology transfer (6KD2).

Taking all the research findings from the 23 gatekeepers into consideration, it is clear that the skills acquired as a result of their education had a real impact on their influence on technology transfer. From investigating the research findings it would seem that while some of the gatekeepers believed that their education benefited them in no measureable way other than to provide credibility amongst the academic community, the gatekeepers in fact gained far more from their education qualifications then they acknowledged. From their responses it became apparent that the gatekeepers' education actually afforded them the ability to be leaders in technology transfer engagement in their IoTs, gain the trust of the academic community and the capacity to gather and absorb knowledge to disseminate it within the IoT. So in essence education provided the individuals identified as gatekeepers in IoTs with the individual capacities emphasised by Allen (1977) and Mitchell (2009) as being essential for effective knowledge transfer within an organisation. Therefore, the gatekeepers' education, unknown to themselves, influenced technology transfer engagement by the academic community through enabling them to facilitate the transfer of knowledge within their IoTs.

7.5 Gatekeepers and their networks as an influencing factor in their ability to influence technology transfer in IoTs

In this study, networking was seen as a vital activity by the gatekeepers as they used their contacts to develop and increase the level of technology transfer engagement in their IoTs. Blau (1977) commented that gatekeepers often look to network contacts for help and guidance and this was evident from the research data as the gatekeepers used network contacts to access gatekeepers in similar positions in other IoTs to gain insight into how successful IoTs engaged their academic community in technology transfer. The gatekeepers also networked amongst themselves so that they could bounce ideas off one another and ask advice on procedures and policies which correlate with research by Walter, Lechner and Kellermanns (2007) that network contacts are used in order to gain access to valuable knowledge through social ties with others.

Cross, Borgatti and Parker (2002) emphasised that individuals rely heavily on their network of relationships to find information and solve problems and this was evident from the research findings. The gatekeepers stated that they viewed their network as a tool to gain access to other gatekeepers and their knowledge while also utilising their network contacts to better understand technology transfer and learn from what other gatekeepers do.

Eisenhardt and Martin (2000) were of the opinion that to use people that have different perspectives and experiences would be effective in the creation of knowledge as it enhances the range of knowledge available. The gatekeepers in this research displayed the unique ability of gathering information from a range of sources and disseminating it to the academic community. As can be seen from the research findings each gatekeeper had a diverse set of contacts in their network and utilised each contact to obtain whatever knowledge they needed for a particular project. For example the group of gatekeepers who managed research centres had the main responsibility of managing the technology that was produced in the centres and facilitating its eventual commercialisation. In order to do this effectively, these gatekeepers used contacts from EI, industry and technology transfer staff and used the information gained from this diverse set of contacts to influence the technology being transferred from the IoTs. The gatekeepers believed influencing technology transfer was not something that one could do alone and that everyone was tied to a network in one form or another.

Swan, Newell, Scarbrough and Hislop (1999) stated that through the process of networking, individuals would become aware of new knowledge. New knowledge, in this study's case, refers to information on technology transfer. This was corroborated by the research findings as it was revealed that through attendance at academic conferences and business meetings gatekeepers were able to gain access to information as to how other gatekeepers were performing in and motivating academic faculty to engage in technology transfer. In particular, the gatekeepers believed that their network contacts with technology transfer staff in the IoT were vital in obtaining information about the other technologies and research that was occurring in the IoT (1-KD2, 1-KD5, 13-KD5, 6-KD2, 2-KD1). The gatekeepers believed that these network contacts increased their influence in technology transfer engagement amongst the academic community.

Bongers, den Hertog, Vandeberg (2003) emphasised that much of the first contact between industry and academia originates from personal contacts. The use of personal contacts by gatekeepers was evident from this study as 21 out of 23 gatekeepers had industry backgrounds and consequently used their personal contacts to aid them in their role in the transfer of technology between the IoT and industry. These gatekeepers believed that they facilitated collaboration between the IoTs and industry due to their own contacts from previous employment. The gatekeepers also used personal contacts to obtain strategic alliances with industry. 13-KD3 used his personal contacts to maintain strategic alliances with industry as he used these alliances to help him in the running of the enterprise platform programme in the IoT to provide the entrepreneurs with information on how to run a business.

Whitley and Frost (1973) indicated that gatekeepers were the primary linking mechanisms to external sources of information through the utilisation of network contacts. From the evidence so far, it may not be unreasonable to state that gatekeepers in this research were the primary linking mechanism to knowledge in the IoTs as they used their network contacts to ascertain industry needs, new knowledge and best practice indicators of successful technology transfer in other IoTs and translate this information to the academic community. The next section of this chapter discusses the role of IoTs in research and innovation process.

7.6 IoTs role in research and innovation

It has been stated that for technology transfer to be effective the relationship between government funding agencies, HEIs and industry needs to be maintained (Etzkowitz and Leydesdorff, 2000). Carlsson and Fridh (2002) summarised that the degree of technology transfer success depends not only on the relationships between the government-HEI-industry but also on the receptivity of the surrounding community, in this study’s case, the academic community in the IoTs.

Smith (2001) stated that higher education institutes can come under severe pressure to provide the government with a return on its investment in the form of commercial technologies. As was stated in Chapter 2, the role of the IoT in establishing a Knowledge Economy in Ireland is not as clear as it could be. To commercialise a technology requires expertise and funding, however IoTs do not receive as much funding as universities to engage in this type of research.

Evidence from the research findings revealed that this has caused gatekeepers to become confused about the IoTs' role in the research and innovation process. The pressure of providing a return in investment was evident from interviews with the gatekeepers as they expressed that they were not treated in the same way as universities in the amount of funding they received for technology transfer even though the SSTI (2006) report and Enterprise Ireland (2008) specifically stated that all HEIs, which includes IoTs, should be engaging in research and innovation. The gatekeepers considered EI's, treatment of IoTs to be inadequate and unsupportive of their efforts to provide the government with a return on its investment. Furthermore, the gatekeepers considered that the approach by EI to only fund IoTs that raised the required 10 million euro research collateral was making it difficult for gatekeepers to encourage the academic community to engage in technology transfer activity when they were not supported for research they were already producing. Consequently, this was having an impact on their influence on technology transfer.

Smith (2001) was of the belief that institutions that were not meeting the targets set by government funding agencies to measure technology transfer would eventually be left behind. Evidence from the research findings revealed that the metrics used by EI to measure technology transfer activity in IoTs were viewed as unobtainable and unfair by the gatekeepers. They believed that the metrics benefited the universities more and did not take into account the other research, such as knowledge transfer (innovation vouchers and innovation partnerships), being performed in IoTs. The gatekeepers believed that EI was only interested in the number of patents and licenses being produced and used these measures to allocate funding to the IoTs.

Even though it was suggested in literature that measurement and reward systems can play a critical role in encouraging knowledge transfer amongst individuals in an organisation (Davenport and Prusak, 1998), the gatekeepers considered the use of metrics by EI to measure productivity in IoTs was unfair and not representative of all the research that was occurring in the IoTs. The gatekeepers, in this study, believed that the use of metrics was not measuring the real progress that was being made by IoTs and hampering the gatekeepers' ability to educate and encourage the academic community to start engaging in technology transfer.

Therefore, by the government using metrics to measure productivity to determine the allocation of funding to HEIs, the IoTs who were not meeting the metrics set out by EI would not obtain the funding. This evidence corroborates Smith (2001) who stated that the poorer performers in technology transfer activity, if not producing the metrics that the funding agencies require, can be omitted from research funding allocation. This point was further emphasised where it was stated by gatekeepers that the metrics used by EI to measure technology transfer activity was driving the behaviour of the IoTs and not encouraging research and innovation activity. The gatekeepers believed that the IoTs were becoming so focussed on producing patents and licenses to obtain funding, that an environment of research and collaboration was not being encouraged in the IoTs. They were of the opinion that this situation was hampering their ability to encourage the academic community to share their knowledge.

This is surprising, as the Technology Transfer Strengthening Initiative, set up by Enterprise Ireland (2008), strived to support and strengthen the technology transfer system in Ireland and encourage innovative activities, yet they use a metric system to only fund those that are performing to a certain level. The government officials believed that if an IoT produced results for the metrics and increased their technology transfer activity then they deserved funding and a dedicated technology transfer officer (Gov1, Gov3). However, the officials stated that IoTs who did not meet the metrics should not receive funding; they felt technology transfer could only be increased if the best performing IoTs were rewarded.

Nicholls (2006), when writing about technology transfer from a university perspective, was of the opinion that universities in general have certain missions, visions, obligations, and research and innovation strategies. If this was the case in Ireland then a standard metric system would be sufficient to measure the technology transfer productivity in HEIs. However, as mentioned in Chapter 2, Ireland has a binary system with both universities and IoTs having different missions and visions (OECD, 2004; Lillis, 2007). Therefore, the use of a standard metric system to measure technology transfer in universities and IoTs may not be the most efficient way for the government to obtain a return on its investment. It is interesting to note that the research findings indicated that EI used this metric system to allocate personal technology transfer officers to the IoTs (Gov1, Gov2, Gov3). Several of the gatekeepers in this research believed that it would be more effective if there was such an officer shared between two or three of the IoTs who were not performing well individually but collectively would meet the benchmarks fixed by the funding agency (DKD2, SKD1, Gov10). However, EI government officials did not consider this a viable method to increase the amount of technology transfer in the IoTs and that the metric system in place was sufficient. EI believed that until someone produced another way of measuring HEI outputs that the current metric system would remain.

Smith (2001) stated that higher education institutes can find it difficult to meet governments' expectations of their research and innovation processes. It would therefore, seem that the research findings are consistent with the opinion of Smith (2001) as the IoTs feel pressured to produce tangible technologies even though they are confused as to their role in the research and innovation process. On one hand they are being told that they should not be engaging in technology transfer (OECD, 2004), on the other hand they are being told by the government that they should be engaging in technology transfer so as to aid the country in becoming a Knowledge Economy (SSTI, 2006). However, when the gatekeepers make an effort and start encouraging the academic community to engage in technology transfer, they are still allocated funding and support based on their metric results which as the evidence has revealed is not achievable by all IoTs.

The research findings also indicated that the IoTs' role in research and innovation was being hampered by the increasing pressure on the IoTs to stimulate the practice of technology transfer amongst the academic community. As was mentioned previously, the gatekeepers found it difficult to encourage others within the IoT to engage in technology transfer and used capabilities in leadership, collaboration with industry and absorptive capacity to gain the trust of the academic community and demonstrate technology transfer as a viable activity. As was mentioned in Chapter 2, the major downfall of the IoT system was that academics were expected to lecture 16 hours per week thereby, hampering the amount of research activity that could occur (Lillis, 2007; Hazelkorn and Moynihan, 2010). Therefore, it is no surprise that the gatekeepers found it difficult to encourage academic communities to engage in technology transfer.

It was mentioned in Chapter 1 that the focus of the Irish government is to achieve a return in the investment it has made to IoTs through the commercialisation of technology transfer outputs. However, the research findings indicated that gatekeepers were not clear on what the IoTs' role was in this endeavour and that the SSTI (2006) report had not made their role in the policy any clearer in contrast to what government officials had stated. Eight out of ten government officials, in this research, did not perceive any problem with the policy or the metrics being used in measuring technology transfer and were adamant that since the publication of the SSTI report the function of IoTs in research and innovation had become clearer (Gov1).

7.7 Chapter Summary

This discussion chapter started with the establishment that the only difference between the six IoTs technology transfer performances was that three of the six IoTs were successful in generating spin-out companies which according to Lockett, Wright and Franklin (2002) was an outcome of a successful technology transfer process in universities. It was found that there was no difference between the gatekeepers' education, experience and network contacts between IoTs that had spin-out companies and those that did not. Hence it has been discovered that although it is true to say that the belief of all 23 gatekeepers that they did influence technology transfer in the IoTs, they did not influence the process of technology transfer itself. It has been found that the gatekeepers were instrumental in the education and engagement of the academic community in technology transfer, gaining the trust of the academic community to start engaging in technology transfer and also the ability to lead the academic community in sharing their ideas with the TTO. It therefore, can be stated that gatekeepers are an important source of knowledge transfer in IoTs through their ability to transfer knowledge to the academic community and creating better structures and policies relating to technology transfer procedures. Hence, it can also be stated that the technology transfer process outlined by Friedman and Silberman (2003) is more complex than what they have outlined in their model. This study has found that gatekeepers are an important part of the overall process and facilitate the education and engagement of the academic community in filing invention disclosures with the technology transfer office (TTO).

Overall the research findings confirm that gatekeepers have an important role in engaging the academic community and their research with the TTO. This is due to their ability to gather and absorb knowledge and disseminate it to the academic community, their ability to be leaders, to be trusted by the academic community, their ability to collaborate with both the academic community and industry and finally their ability to provide/facilitate support structures from the IoT to the academic community. This finding concurred with Allen (1977) who stated that gatekeepers were the knowledge source of an organisation and possessed certain abilities attributed to knowledge transfer and the success of technology transfer.

However, the research findings indicated that gatekeepers believed their knowledge transfer capabilities and capacities were attributed to skills gained during their previous employment and not to skills gained as a result of their education qualifications. Upon further analysis of the data, the researcher found that the gatekeepers' skills gained during their education provided much more than credibility amongst the academic community. In essence, education was the source of the gatekeepers' ability to gather, absorb and disseminate knowledge to the academic community (Cohen and Levinthal, 1990), facilitate trust building amongst the academic community (Duflo and Saez, 2000; Sorensen, 2001; Goh, 2002) and to be leaders within the IoT regarding technology transfer (Kotter, 1990). The gatekeepers also considered their network contacts to be vital to their role in engaging the academic community in technology transfer. In fact 20 out of 23 gatekeepers believed their contacts with EI to be the most important in their network. This outcome was surprising mainly due to the insistence of the gatekeepers that EI did not provide IoTs with adequate funding or guidance in technology transfer.

Furthermore, the research findings indicated that gatekeepers were unsure of the IoTs' role in the research and innovation process in Ireland. As was mentioned previously, the Irish government is requiring a return on the investment it has made in research and innovation in IoTs since 2006. However, while IoTs are being encouraged to engage in technology transfer they are still reminded by agencies such as OECD (2004) that their role is to engage with industry and teach and not to engage in research. This has caused much confusion and discontentment amongst the gatekeepers in this research as they do not understand why, when they actively try to engage in technology transfer, they do not receive adequate help and guidance. The next chapter draws together the main conclusions and limitations of this investigation as well as presenting suggestions for further studies as a complement to the current research.

Chapter 8: A Process of Technology Transfer

8.1 Introduction

The aim of this research was to examine whether the 23 gatekeepers identified in this study influenced technology transfer in IoTs. As discussed previously, technology transfer has been described by Friedman and Silberman (2003) as a process that runs from invention disclosures shared by academic faculty to eventual jobs/wealth and start-up companies. While the researchers did make reference to the role of the Technology Transfer Office (TTO) in technology transfer and their part in fostering relationships between industry and the Higher Education Institute (HEI) they did acknowledge the need for quality faculty to share their knowledge in order for the process to occur. Despite certain literature stating that successful technology transfer within an organisation requires individuals who are capable of gathering and disseminating information, there has been limited research focused on the influence of gatekeepers on technology transfer. Therefore, this study employing an interpretative research approach, including the use of semi-structured interviews, aimed to bridge this gap in literature by examining how individuals (gatekeepers) influence technology transfer in IoTs.

This chapter begins by addressing the main contributions to knowledge and understanding of the influence of gatekeepers on technology transfer and the implication of the research findings on future government technology transfer strategies. Also included in this chapter are the limitations associated with this research and recommendations for future research on technology transfer in IoTs and future implementation of government policies.

8.2 Contribution to knowledge and the examination of gatekeepers' influence on technology transfer in IoTs

This research study focussed specifically on whether gatekeepers influenced technology transfer in IoTs. This study highlighted that the 23 gatekeepers believed that they influenced technology transfer in their IoTs. This research has contributed to knowledge and understanding to what extent gatekeepers influence technology transfer in IoTs and has established that gatekeepers are a critical source of technology transfer engagement and an important source of knowledge transfer in IoTs

This research has found that while gatekeepers do not have a direct influence on the technology transfer outputs of the IoTs in this study, they had a more important role in the education and engagement of the academic community and researchers in technology transfer so that invention disclosures would be filed with the TTO. It is therefore, proposed by this research study that the technology transfer model by Friedman and Silberman (2003) is more than just the filing of invention disclosures to the TTO leading to start-up companies being formed it requires gatekeepers to create awareness and the benefits of engaging in the process in order for invention disclosures to be filed. Secondly, this study contributes to literature on the knowledge transfer process and the individual capacities which influence it. Thirdly, this research provides some policy implications in terms of policies enforced by government funding agency employees. Key findings relating to each of these dimensions are briefly discussed in this section.

This study provides an insight into the technology transfer process that occurs in higher education institutes, focussing on the six IoTs examined in this research study. Friedman and Silberman (2003), acknowledged in their research study that additional measures of the technology transfer process that occur in HEIs could be measured using the experience of the people involved in promoting technology transfer and the support structures available for the academic community in engaging in the process. This study has contributed to literature on technology transfer by highlighting the existence of gatekeepers to assist the TTO in encouraging and engaging the academic community in sharing their inventions. The findings from this research have found that gatekeepers are not directly influential in the number of invention disclosures and patents filed by an IoT but are a substantial influence in the generation of knowledge surrounding the benefits to the academic community of engaging in technology transfer and in the creation of support documents and structures so that the academic community’s engagement in technology transfer is as simple as possible.

The findings from this study agreed with Garud and Nayyar (1994) that successful technology transfer requires certain individuals to gather, absorb and disseminate knowledge and transfer it to others in an organisation. Its success in fact relies on the existence of certain individuals who had the ability to be leaders, to be trusted by the academic community, to provide/facilitate organisational support structures, to be collaborators and finally individuals who are dedicated to transferring the relevant knowledge required by researchers involved in the commercialisation of technology.

In fact the individuals identified as gatekeepers, in this study, believed that if they were not present then technology transfer would not happen at all. Therefore, this study provides an important finding regarding the importance of gatekeepers in the encouragement of academics not to be fearful of disclosing their inventions to the TTO. Hence, it can be stated that the technology transfer process, outlined by Friedman and Silberman (2003), requires the presence and influence of gatekeepers in order for the step by step process to be effective. The skills gained from gatekeepers' education, previous experience and network contacts all contribute to their ability to motivate, inspire and influence the academic community to engage in technology transfer. Through providing the academic community with relevant information and the benefits associated with engaging in the process, gatekeepers have the ability to motivate and inspire academic faculty to engage in technology transfer. As a result the gatekeepers facilitate and encourage the academic community in filing invention disclosures and support them in the patenting process through the production of support structures and documents. A potential result of this encouragement is the formation of new start-up companies that will eventually lead to the creation of jobs and wealth in the regional and surrounding economies. As a result of this important finding and contribution to knowledge transfer and technology transfer literature, Figure 8.1 adapts the technology transfer process outlined by Friedman and Silberman (2003) and takes into account the influence of gatekeepers. The Figure shows that the process depicted by Friedman and Silberman (2003) needs to include gatekeepers as an important asset to the TTO in order to encourage quality academic faculty to engage with them and share their ideas so that the technology transfer process can start.

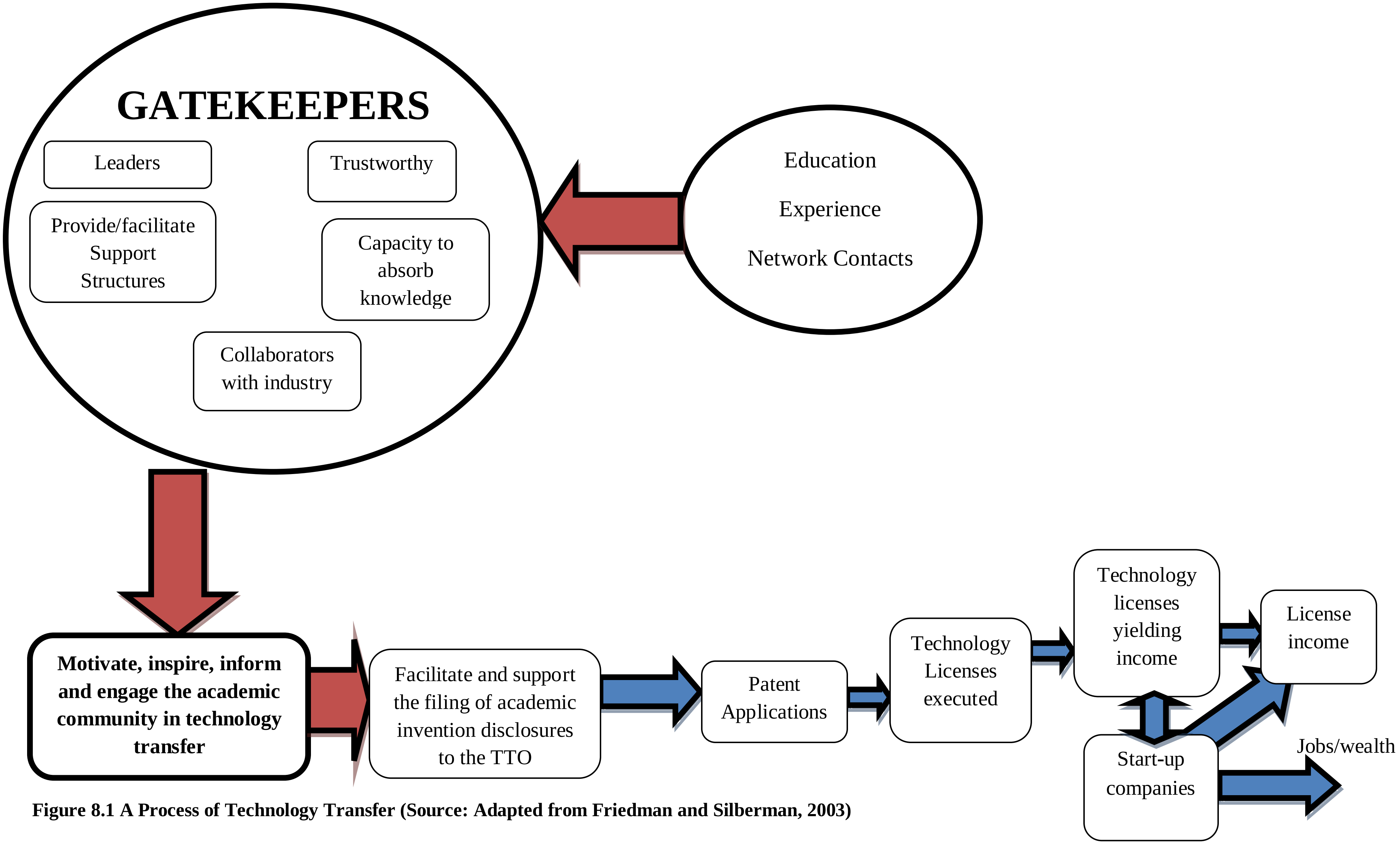

Figure 8.1 A Process of Technology Transfer (Source: Adapted from Friedman and Silberman, 2003)

This result has implications for researchers, academic communities and government funding agency employees as it indicates that gatekeepers, while not directly influencing the number of invention disclosures and patents filed by their IoTs, they are an important source of knowledge creation and awareness amongst the academic community so that they are more willing to engage in technology transfer and share their ideas with the TTO.

Friedman and Silberman (2003) highlighted in their research that there was a gap in literature into how the experience of the TTO influences technology transfer. This research study has highlighted that it is in fact the education and experience of gatekeepers and their knowledge transfer qualities that increase the TTO's influence on technology transfer. It was established in Goh's (2002) study of effective knowledge transfer that success was determined by an organisation that had a culture of leadership, trust, support structures, collaboration and absorptive capacity. Through the findings of this study it was found that the individuals identified as gatekeepers in IoTs had the ability to influence an organisation's culture and implement its design as a result of the skills acquired from their education and experience. This study contributes to the literature on gatekeepers through examining the link between gatekeepers' characteristics summarised by Allen (1977) and organisational knowledge transfer capacities outlined by Goh (2002). This study also contributes to literature on gatekeepers by illustrating how skills gained during education and previous experience and network contacts can contribute to knowledge transfer. Consequently, it can be stated, on the basis of this research, that gatekeepers' real influence on technology transfer is in their ability to lead, provide and facilitate support structures, be trusted by academic communities and industry, collaborate with industry and absorb knowledge as a result of these skills. These skills in turn, enable the gatekeepers to influence the transfer of technology occurring in IoTs. Figure 8.2 demonstrates this contribution to literature.

As can be seen from Figure 8.2 the individuals identified as gatekeepers from this research possess the capacities of gatekeepers (Allen, 1977) and helped facilitate and support the organisational culture of IoTs (Goh, 2002). As shown in Chapter 5, 6 and 7 the gatekeepers in this research study had the capacity to be leaders in their IoTs by contributing to innovation and creativity within the IoT and facilitate a culture that encouraged the academic community to engage in technology transfer. Furthermore, as a result of the skills gained during their education and previous experience, the gatekeepers gained the trust of the academic community and encouraged them to share their knowledge with the TTO. Also the gatekeepers displayed absorptive capacities in their ability to source knowledge from their network contacts, understand this knowledge and disseminate it with the academic community. The gatekeepers also used their skills to provide and facilitate research policy and technology transfer support documents to increase the engagement of academic faculty. Finally, the gatekeepers in this research facilitated collaboration projects between the IoTs and industry and government funding agencies through utilisation of their network contacts. Therefore, it can be concluded that the individuals identified as gatekeepers in this research have shown through their skills gained in education and previous experience and utilisation of network contacts that they are gatekeepers (Allen, 1977), are facilitators of an IoT culture that promoted research activity Goh (2002) and have the unique ability to gather and disseminate vital knowledge within their IoTs.

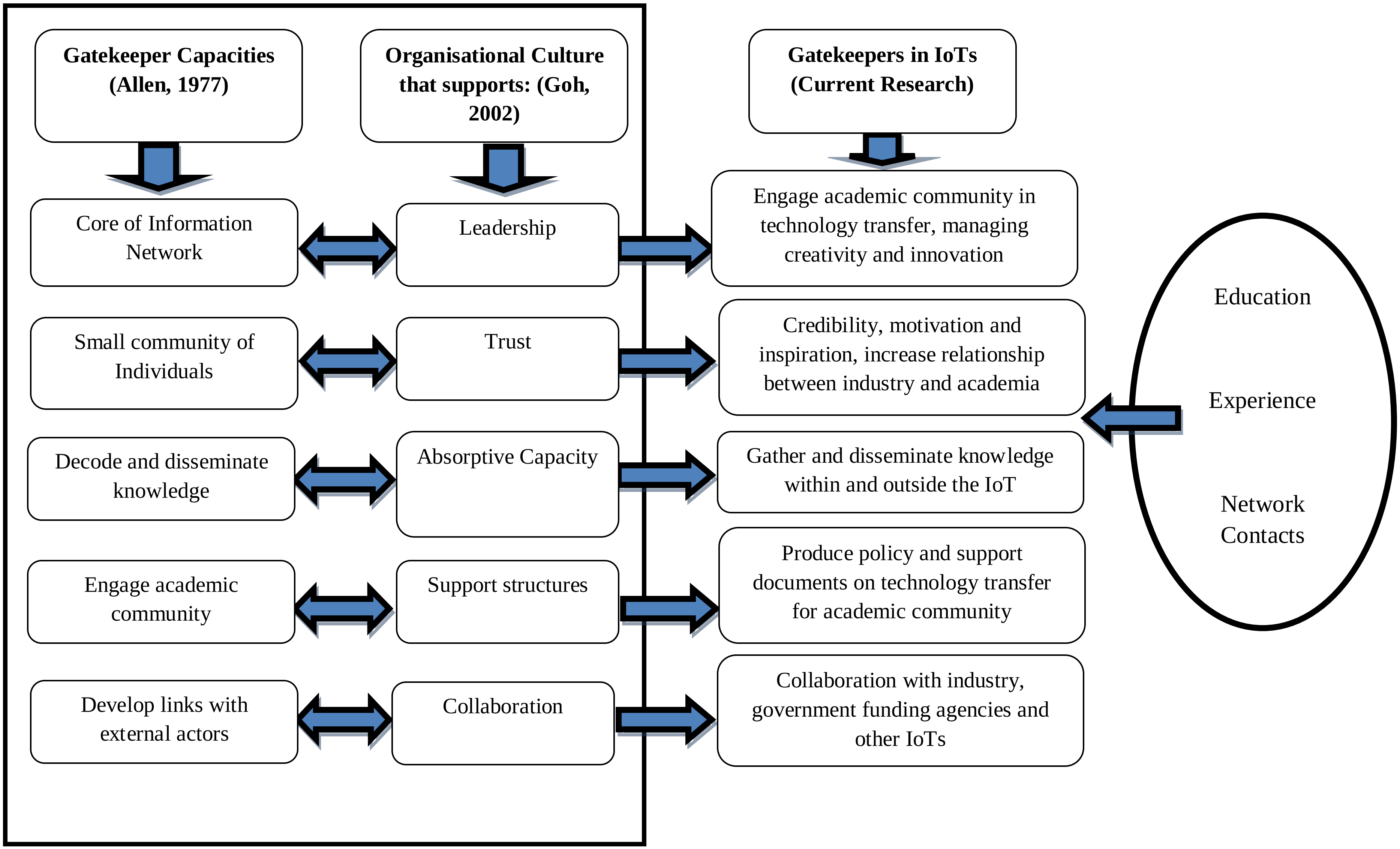

Figure 8.2 Gatekeepers and knowledge transfer capacities (Source: Current Research)

In summary the main conclusions from the study show that the gatekeepers' presence in IoTs is an integral part for the creation of knowledge and awareness of technology transfer. Gatekeepers are also important in educating academic researchers of the benefits of engaging in technology transfer and the benefits of sharing their knowledge and ideas with the TTO. It has been found that gatekeepers are key to the sourcing of academic technology ideas and producing the support structures that enable the academic community to understand technology transfer and become more involved in the process. This statement is justified by the evidence from the current study. The evidence also suggests that gatekeepers facilitate the unique organisational culture needed to transfer knowledge which they achieve through their education, experience and network connections. Therefore, it is concluded that technology transfer cannot occur without unique individuals to gather and disseminate knowledge as per conclusions from Garud and Nayyar (1994). This study has concluded that gatekeepers are a vital asset to technology transfer engagement in IoTs. Therefore, from a conceptual perspective, the research findings presented in this thesis stress the need for gatekeepers' importance to technology transfer processes to be articulated in a more comprehensive way then it is currently in literature.

This research study confirms that the government need to make the role of IoTs clearer in the research and innovation process. The research findings showed that gatekeepers are still confused as to the IoTs' role in technology transfer mainly because of organisations like the OECD (2004) stating that they should not engage in research. In fact the research findings illustrated that the IoTs were hampered in their progression in research activity due to the fact that the academic community are contractually obliged to lecture 560 hours per year or 16 hours per week which is often re-interpreted by some academics and their trade unions as only doing 16 hours work per week (Hazelkorn and Moynihan, 2010). However, the working week consists of 37.5 hours and while academics only lecture 16 of those hours they also require time for preparation of lectures, correction of assignments and supervision of student theses thereby, hampering the actual amount of time available to engage in research.

8.2.1 Implications of findings on future technology transfer for both government funding agencies and IoTs.

Friedman and Silberman (2003) acknowledged that there existed a gap in literature regarding the funding of the technology transfer and the TTO. This research study provides some interesting findings for government funding agencies and how they allocate funding and support to IoTs. The research findings in this thesis established that gatekeepers relied heavily on their network contacts to motivate and engage the academic community in technology transfer. However, an interesting finding from this study was that EI was a prominent part of 20 out of the 23 gatekeeper networks despite the fact that it was also established that the gatekeepers did not believe EI were providing enough support for the IoTs' technology transfer processes. The gatekeepers considered the metric system used by EI to allocate funding was not effective and was in danger of isolating the poorer performing IoTs. The gatekeepers further believed that the presence of a metric system whose primary aim was to measure technology transfer and the results of which were used as a method of allocating funding to the higher education sector was hampering technology transfer engagement in their IoTs. The gatekeepers further believed that their role of encouraging and motivating the academic community to engage in technology transfer was also difficult due to the lack of support and funding from EI as a result of the implementation of the metric system. This is an important finding for government funding agencies such as EI as the findings indicate the current metric system is not operating effectively.

Furthermore, it is a conclusion of this research that the policy relating to technology transfer in IoTs needs to be clarified. If the Irish government wants to achieve a return on their investment then current policy towards research and innovation in IoTs may have to change. The achievement of this return in investment relies on many factors, one of the main factors being the commercialisation of technology transfer outputs stemming from IoTs however, it seems that government research policies are aimed more at universities than IoTs. Increases in the commercialisation of technology requires increases in the amount of academic faculty becoming involved in technology transfer however, it has been concluded from the research findings that IoT academics are not allocated enough time in their schedules to engage in research. Therefore, the amount of time allocated to IoT academics to engage in technology transfer during working hours needs to be revisited as an important part of the IoT strategy going forward. Hence, it is a recommendation of this research that if academics are expected to engage in technology transfer then the amount of time they are allocated to do so needs to be examined by their IoT and incentives put in place to facilitate gatekeepers in their efforts in encouraging the academic community.

In summary, the future evolution of increased technology transfer in IoTs will be impacted by the existence of unique knowledge transfer individuals such as gatekeepers who have a key role in creating knowledge and awareness of the benefits of engaging in technology transfer to the academic community. Technology transfer is expected to increase in the IoT sector over the next number of years. This is due to the fact that the Irish government is now focussing more on research and innovation and commercialising technology stemming from IoTs and gaining a return on the investment they have made. Therefore, a stronger and more formalised technology transfer plan needs to be established by IoTs so that they can identify more gatekeepers and start engaging the academic community in technology transfer.

Also government funding agency employees need to adapt the way they implement certain policies so that the needs of IoTs are met and the poorer performers are not left behind. This study therefore, provides important contributions not only to reasons why IoTs find it difficult to provide a return on the investment provided to them by EI but also as to a reason why gatekeepers sometimes find it difficult to encourage and engage the academic community in commercialising their technology.

8.3 Limitations

There are a number of limitations inherent with this research study which has particular reference for the conclusions and recommendations drawn. In particular, one of the main limitations associated with this research was that it only investigated the opinions of people in the six IoTs that matched the preferred benchmarks used for this research. Consequently, despite efforts to manage the research project in a consistent, semi-structured and unbiased manner, it is possible that personal values, bias and reactivity may have arisen to a degree and therefore, impact on the validity and reliability of the research data. However, these findings must be interpreted in context as not all IoTs participated in the research and not all eligible IoTs participated in the study. The opinions of these gatekeepers in six IoTs may not be the same opinions of the gatekeepers that may or may not exist in the remaining eight IoTs. Such findings would have been of particular interest to higher education authorities and technology transfer personnel and would have provided important recommendations to the importance and relevance of gatekeepers to the promotion and motivation of technology transfer amongst the academic community.

Secondly, this research examined the skills gained from gatekeepers' education, previous experience and network contacts as a contributing factor to their influence on technology transfer engagement amongst the academic community. The study examined education and previous experience as it had been stated by Venkataramen (1997) and Shane (2000) that these traits had an impact of the leadership and trust capacities of gatekeepers. However, it was not established whether any other underlying factors impacted on the ability of gatekeepers to influence technology transfer engagement.

Also, the research findings indicated that the gatekeepers believed that technology transfer would not occur in their IoTs without their presence. However, this study did not investigate whether gatekeepers actually motivated academic faculty in the IoTs. It would have been very informative to have been able to interview members of faculty to see if gatekeepers actually increased their level of participation in technology transfer.

Finally regarding the research respondents themselves, the nature of utilising qualitative methods introduces potential concerns about the validity and reliability of the gathered data. The use of semi-structured interviews to gather this data has the potential threat that inaccurate analysis has been given surrounding the gatekeepers' relationships and collaboration with each other. This type of threat cannot be ignored despite substantial efforts to reduce this risk in this current study.

8.4 Recommendations for Future Research

There are a number of key findings emanating from this study which would be useful to explore in more detail in future research. As mentioned previously, this research only investigated a selective sample of the 14 IoTs from the selection criteria. Hence; it is proposed that a similar study be conducted to ascertain the opinions of the remaining eight IoTs in the sector in order to establish whether the results from this study are consistent across the entire IoT sector. Furthermore, it is proposed that a similar study be conducted within the university sector to establish whether the results found in this study also apply to the university sector gatekeepers. For instance the findings could suggest the important and urgent need to investigate the way in which the different sectors are treated regarding technology transfer funding allocation.

It would be interesting, through a case study based approach, to perform a comparative analysis between higher education institutes in Ireland and those in other European countries. This future study would provide insights as to whether the factors that exist in Irish IoTs are the same in other countries and if other regions and education institutes in Europe are better able to engage in technology transfer. This research would also potentially provide the higher education authorities in Ireland with valuable information as to how Irish IoTs compare to their European counterparts and also provide clearer guidelines to government funding agency employees as to how to effectively gather a return from their investment in technology transfer thus far.

It would also be interesting to interview academic faculty in the IoTs from this research study in order to establish whether they believed the actions of gatekeepers motivated and inspired them to engage in technology transfer or whether it was as a result of other factors. The results of this type of study could highlight the full impact of gatekeepers on technology transfer within IoTs.

This thesis represents a starting point for future research studies intended to widen the empirical evidence regarding the extent of the influence of gatekeepers on technology transfer. This thesis has contributed to the investigation and understanding of the role of gatekeepers and their impact and influence on technology transfer in IoTs. It is believed that the findings presented in this study will have important implications for policy makers, technology transfer personnel, higher education authorities and government funding agencies in Ireland.

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Appendices

Appendix One

Incubator Manager Codes

Institute of Technology	Incubation Manager Codes
IoT1	Manager1
IoT2	Manager2
IoT3	Manager3
IoT6	Manager6
IoT10	Manager10
IoT13	Manager13

Appendix Two

Gatekeeper Codes

Institute of Technology	Gatekeeper 1	Gatekeeper 2	Gatekeeper 3	Gatekeeper 4	Gatekeeper 5
IoT1	1-KD1	1-KD2	1-KD3	1-KD4	1-KD5
IoT2	2-KD1	2-KD2	2-KD3	2-KD4	2-KD5
IoT3	3-KD1	3-KD2	3-KD3		
IoT6	6-KD1	6-KD2			
IoT10	10-KD1	10-KD2	10-KD3		
IoT13	13-KD1	13-KD2	13-KD3	13-KD4	13-KD5

Appendix Three

Key Government Official Codes

Codes For Key Government Officials	Government Agency Affiliated with
Gov1	Enterprise Ireland (EI)
Gov2	Enterprise Ireland (EI)
Gov3	Enterprise Ireland (EI)
Gov4	Enterprise Ireland (EI)
Gov5	Higher Education Authority (HEA)
Gov6	Higher Education Authority (HEA)
Gov7	Institutes of Technology Ireland (IoTi)
Gov8	Forfas
Gov9	Science Foundation Ireland (SFI)
Gov10	Higher Education Institute (HEI)

Appendix Four

Incubator Manager Interview Questions

1. How does the technology and knowledge transfer process operate within the IoT?
    - What are the main departments/schools that are involved in the technology transfer process?
    - Who are the main people within these departments that are involved in the process?
    - What are their roles within their respective departments?

2. What is the main technology that is transferred within the IoT?
    - Why is there a focus on this particular technology and not others?
    - What are the main technologies that are transferred into/from this institute?
    - Which is the most prominent/dominant?
    - Why is this technology the most prominent/dominant technology?

3. What are your main responsibilities as incubator manager?

4. Do you have a role in the transfer of technology from and within the IoT? If yes?
    - What are your main responsibilities within the process?
    - Do you see yourself as a gatekeeper within the technology transfer process?
    - If no? Why do you not see yourself as a main player in the process?

5. Who are the gatekeepers (individuals) that drive the technology transfer process within the institute? Who initiates the process?
    - Why are they the gatekeepers?
    - What are your reasons for stating that they are gatekeepers in the process?
    - What do they do within the process that makes them gatekeepers?
    - What are their main responsibilities towards the process?
    - Are they part of the institute staff?
    - Where do they work? What department/organisation?
    - What is their status within the organisation? Senior or junior?
    - What is their role within that department/organisation?
    - Do they have linkages with people or industry outside of the IoT?
    - Are they involved in research projects that are ongoing in the IoT?
    - How much of their role is actually focused on technology transfer process?
    - How is the centre funded? Are there any additional funding sources for core activities?

6. In your opinion how effective is the technology transfer process within the IoT? What is the reason for your answer?
    - What is your opinion on the systems and structures of the process (es) within the IoT?
    - In your opinion, what are the strengths and weaknesses of the process (es)?

7. Do you have any suggestions on how things could be done differently or improved/retired within the technology transfer process?

Appendix Five

Gatekeeper Interview Questions

1. What is your role in the transfer of technology in the IoT?
   What are your main responsibilities with regards to the technology transfer process?

2. What is your role in the IoT?
   - What are your main responsibilities as …….?
   - Who are the key people that you are in contact as part of your role?
   - Are they part of the institute staff?
     If not what institutions/organisations do they work in/for?

3. To what extent does your role affect the technology transfer process?
   - In what way does your role affect the structure of the process?
     Please give reasons for your answer.

4. What is your own background experience?
   - In what industry sector was your previous employment in?
   - What was your role in your previous employment?
   - Do you use any of the skills you acquired in previous employment in your role in the technology transfer process within the IoT?
     i. How do they help you in your role in the technology transfer process?

5. Does your experience gained in your previous roles help you in your role in the technology transfer process?
   - How does your experience help you in your role?

6. What is your highest level of education qualification?
   - To what extent has it helped you in your role in the technology transfer process?

7. Do you use a network of contacts to help you in your current role in the technology transfer process within the IoT?

   - Why have you chosen these organisations as the key contacts in your network?
   - How do these key network contacts help you in your role in the technology transfer process?
   - How do you use this network in your role in the technology transfer process?
   - Are they separate to the network of people that you contact for your current role within the institute?

8. In your opinion how effective is the technology transfer process within the IoT? What is the reason for your answer?

   - What is your opinion on the systems and structures of the process (es) within the IoT?
   - In your opinion, what are the strengths and weaknesses of the process (es)?

- Do you have any suggestions on how things could be done differently or improved/retired within the technology transfer process?
- Is the transfer technology process built into the institutes metrics?
- Is it clear from a policy perspective that TT is important to the economy and should be promoted within the IoT?
- Is TT important to the IoT?

9. What technologies do you think Ireland should focus and/or put investment in, in order to advance Ireland as an innovative, smart economy?

Appendix Six

Key Government Official Interview Questions

During the course of my research your name was given to me as a key player in the technology transfer process within the government agencies that help IoTs in the technology transfer process.

1. What is your role in the transfer of technology in (EI, SFI, HEA, IoTi, Forfas)?
    - What are your main responsibilities with regards to the technology transfer process?
2. To what extent does your role affect the technology transfer process in the IoTs?
3. Do you use a network of contacts to help you in your current role in the technology transfer process within the organisation?
    - How did you create the network?

4. What is your own background experience?
    - Do you use any of the skills you acquired in previous employment in your role?
    - How do they help you in your role as regards technology transfer and IoTs?

5. Are you aware of the fragmentation of the process within higher education institutes? In your opinion are IoTs treated differently to Universities? Yes or No? Please Explain.

6. In your opinion is there a TT policy in Ireland?
    - What is that policy?
    - How would you explain what that policy is for IoTs?

7. What is your opinion on the lack of benchmarks for measuring technology transfer activity in Ireland?
8. Do you think that your funding agency have set out clear definitions on start-ups and academic start ups for IoTs to follow?
9. Do you think metrics are the most efficient way of measuring an IoTs technology transfer activity?
    - Do you think it is fair that all IoTs are measured on the same metrics? Some are at different stages.
10. How do you allocate funding to IoTs and the different research groups within it from a TT perspective?
11. Do you think training courses are enough for people in IoTs with the responsibility for technology transfer?
12. What is your opinion on the lack of a dedicated technology transfer officer in all IoTs in the country? Why do some get a resource and others do not?
13. Do you think there should be a database of all the innovation vouchers that are being done by other colleges?

14. In your opinion how effective is the technology transfer process in IoTs? What is the reason for your answer?
    - What is your opinion on the systems and structures of the process (es) within IoTs?
    - In your opinion, what are the strengths and weaknesses of the process (es)?
    - Is the transfer technology process built into the institutes metrics?
    - Is it clear from a policy perspective to IoTs that TT is important to the economy and should be promoted within the institutes?