

**Beyond the 'Triple Helix':  
Examining the Implementation Process of  
Knowledge-based Innovation  
in the North East of England**

**DBA Thesis**

**August 2006**

NEWCASTLE UNIVERSITY LIBRARY

-----  
205 36668 5  
-----

Thesis L8410  
-----

**Lucy Yang Lu**

**Newcastle University Business School  
Newcastle University**

**Submitted in fulfillment of the requirements of the  
degree of  
Doctor of Business Administration**

## **Declaration of Author's Right**

The copyright of thesis belongs to the author under the terms of the United Kingdom Copyright Acts, as qualified by Newcastle University's Regulation. Due acknowledgement must be made of the use of any material contained in, or derived from this thesis.

@ 2006, Lucy Yang Lu

# Table of Content

Abstract	ii
Acknowledgment	iv
List of Figures	v
List of Tables	vi
List of Abbreviation	vii
<b>Introduction</b> .....	<b>1</b>
I Statement of Problem and Context .....	1
II Research Focus and Rationale .....	8
III Research Aims & Objectives .....	9
IV Research Strategy.....	10
V Original Contribution to knowledge .....	11
VI Structure of the Thesis .....	11
<b>Chapter 1 Strategic Context of Knowledge-based Innovation</b> .....	<b>14</b>
1.1 Introduction .....	14
1.2 Understanding Knowledge-based Innovation .....	15
1.2.1 Defining Innovation .....	15
1.2.2 Innovation as Collective Actions .....	20
1.2.3 Knowledge-based Innovation .....	22
1.2.4 Challenges of Knowledge-based Innovation .....	25
1.2.5 Summary .....	28
1.3 Regional Focus of Knowledge-based Innovation .....	29
1.3.1 Importance of Regional Innovation .....	29
1.3.2 Regional Innovation System (RIS) .....	31
1.3.3 Learning Region.....	37
1.3.4 Summary .....	39
1.4 Triple Helix of Knowledge-based Innovation .....	40
1.5.1 The Concept of Triple Helix .....	40
1.5.2 Transformational Relations within Triple Helix .....	43
1.5.3 Critical Issues of Triple Helix.....	47
1.5.4 Implementing Triple Helix in a Regional Context.....	49
1.5.5 Summary .....	51
1.6 Conclusion.....	52
<b>Chapter 2 Beyond Triple Helix: Implementing Knowledge-based Innovation</b> ....	<b>54</b>
2.1 Introduction .....	54

2.2 Forming Triple Helix Networks .....	55
2.2.1 The Study of Network in Innovation .....	55
2.2.2 Triple Helix as Innovation Networks .....	57
2.2.3 Challenges of Forming Innovation networks.....	59
2.2.4 Summary .....	62
2.3 Implementing Triple Helix Networks.....	62
2.3.1 Activating Innovation Networks .....	63
2.3.2 Information, Knowledge and Innovation Networks .....	65
2.3.3 Coordination Mechanisms .....	68
2.3.4. Summary .....	72
2.4 Managing the challenges of Triple Helix networks.....	73
2.4.1 Multi Processes and Interactions .....	73
2.4.2 Managing Change .....	75
2.4.3 Building Learning Capacity .....	77
2.4.4 Summary .....	80
2.5 Network Approach to Policy Implementation.....	81
2.5.1 Traditional Policy Implementation .....	81
2.5.2 Network Approach to Implementation.....	82
2.5.3 Summary .....	83
2.6 Conclusion.....	84
<b>Chapter 3 Research Methodology .....</b>	<b>85</b>
3.1 Introduction .....	85
3.2 Case Study Strategy .....	85
3.2.1 Rationale of Case Study .....	86
3.2.2 Case Study Design .....	90
3.2.3 Unit of Analysis .....	94
3.2.4 Data Collection Methods .....	95
3.2.5 Validity and Generalization.....	97
3.2.6 Summary .....	100
3.3 Implementing Case Study.....	101
3.3.1 Outline of Research Process .....	101
3.3.2 Conducting Interviews .....	103
3.3.3 Presenting and Analysing Data .....	106
3.3.4 Summary .....	112
3.4 Limitations of Research.....	112
3.5 Conclusion.....	114
<b>Chapter 4: Background and Innovation Strategy in the North East of England</b> .....	<b>116</b>
4.1 Introduction .....	116
4.2 Knowledge Economy and Innovation in the UK .....	116

4.2.1 The Government Competitiveness White Paper .....	116
4.2.2 University – Industry Collaboration - Lambert Review .....	118
4.2.3 The Science & Innovation Investment Framework .....	120
4.3 Creating the Knowledge Economy in the North East of England.....	122
4.3.1 Context of North East of England.....	122
4.3.2 Raising the Potential of North East Research Base – ADL Review .....	124
4.3.3 Knowledge-based Innovation Strategy .....	126
4.4. The Formation of Strategy for Success (SfS) Networks .....	127
4.4.1 The Science & Industry Council.....	128
4.4.2 The Regional Centre of Excellence .....	128
4.4.3 Regional Cluster Networks (RCN).....	133
4.4.4 Inward Investment Networks (IIN).....	134
4.5 University Research Networks (RN).....	136
4.5.1 Technology Transfer Office (TTO).....	136
4.5.2 Knowledge Transfer Partnership (KTP) .....	137
4.5.3 Knowledge House Networks (KHN).....	139
4.7 The Implementation of the Knowledge-based Strategy .....	140
4.7.1 A Demonstration of SfS Policy Networks .....	140
4.7.2 The Conceptual Mapping of Triple Helix Innovation Networks .....	141
4.8 Conclusion.....	142
<b>Chapter 5 A Pilot Study of Regional Inward Investment Networks .....</b>	<b>144</b>
5.1 Introduction .....	144
5.2 The Inward Investment Strategy and Knowledge Economy.....	145
5.2.1 Regional Inward Investment Strategy.....	145
5.2.2. Inward Investment Innovation Networks.....	147
5.3 The Process of Inward Investment Networking .....	149
5.3.1 Principles of networking .....	149
5.3.2 Nature and Content Networking Tasks .....	152
5.3.3 Communication.....	153
5.3.4 Perceived Roles within Networks.....	157
5.3.5 Summary .....	158
5.4 Implications of Findings.....	160
5.4.1 Information Configuration.....	160
5.4.2 Managing Dynamic Changes.....	162
5.4.3 Coordination Mechanisms .....	163
5.4.3 Issues of learning .....	166
5.5 Conclusion.....	167
<b>Chapter 6 Presentation of the Main Study .....</b>	<b>169</b>
6.1 Introduction .....	169
6.2 Building Network Relations within the Triple Helix .....	169

6.2.1 CoEs and Industry Relations.....	169
6.2.2 CoEs and University Relations .....	178
6.2.3 CoEs and Government Relations.....	184
6.2.4 The Triple Helix networks within Sfs .....	187
6.3 Networking Challenges within Triple Helix .....	191
6.3.1 Confusion of Networking Roles .....	191
6.3.2 Congruence of Strategic Focus .....	193
6.3.3 Coping with Institutional Culture .....	197
6.3.4 Challenges of Partnership .....	201
6.4 Conclusion.....	204
<b>Chapter 7 Analysis and Discussion of Research Findings.....</b>	<b>207</b>
7.1 Introduction .....	207
7.2 Issues need to be addressed within Triple Helix Networks.....	208
7.2.1 The ‘Hidden’ Strategic Intentions .....	208
7.2.2 Lack of Institutional Arrangement.....	210
7.2.3 Different Perceptions .....	211
7.2.4 Diversified Motivations and Interests of Innovation .....	212
7.2.5 Coordination Issues within Triple Helix .....	213
7.2.6 Leading Partnership Networks.....	217
7.2.7 Transforming Relations within Triple Helix.....	219
7.2.8 The Context Matters .....	222
7.2.9 Summary .....	225
7.3 Developing Learning Capacities within Triple Helix.....	226
7.3.1 Learning Difficulties.....	226
7.3.2 Managing Learning for Knowledge-based Innovation.....	228
7.3.3 Summary .....	230
7.4 The Shaping of Effective Triple Helix .....	231
7.4.1 Triple Helix: From Ideal to Feasible.....	231
7.4.2 Effective Model of Triple Helix in the North East of England.....	233
7.4.3 The Strategic Value of CoEs .....	234
7.4.4 The Organizational Dysfunction.....	236
7.4.5 Summary .....	237
7.5 A Strategic Framework of Implementing Knowledge-based Innovation.....	238
7.6 Conclusion.....	240
<b>Chapter 8 Conclusions and Recommendation .....</b>	<b>242</b>
8.1 Introduction .....	242
8.2 Reflections on Research Objectives .....	243
8.3 Synthesis of Overall Findings .....	244
8.3.1 Importance of Structural Facilitation.....	245
8.3.2 Strategic Leadership in Triple Helix Relations.....	246
8.3.3 Pre-conditions for Effective and Appropriate Implementation.....	248

8.3.4 Managing Transforming Process .....	251
8.3.5 Summary .....	253
8.4 Contribution to Knowledge .....	254
8.4.1 Theoretical Contribution .....	254
8.4.2 Practical Contribution and Policy Implication.....	255
8.5 Recommendations for Further Research .....	257
<b>Reference .....</b>	<b>261</b>
<b>Bibliography .....</b>	<b>275</b>

## **Abstract**

The capacities of innovation have been widely recognized as central to the knowledge economy. The notion of interactive innovation based on collective knowledge has broken the traditional view of innovation which is focused on individual firms and industries. There is an increasing trend towards collaboration not only between different academic disciplines, but also between academics, business practitioners and government. Such a trend is manifested in the emerging concept of Triple Helix relations of university-government-industry, which has been seen as the key driver and strategic model for creating knowledge-based innovation. However, critically reviewing the literature reveals that the appropriateness and effectiveness of implementing Triple Helix remain problematic.

This research aims to examine and evaluate the processes of creating knowledge-based innovation through successful implementation of Triple Helix relations of university-government-industry to generate innovation capacities in the North East of England. The TH in this thesis is regarded as a heuristic model of creating knowledge-based innovation and a guide to innovation policy making. Following the establishment of a theoretical framework for analyzing the process whereby innovation capacities are generated and enhanced, a pilot study was conducted with the involvement of the regional government agency and sub-regional partners. Furthermore, a main study was carried out and data were collected from 48 in-depth semi-structured interviews with senior government officials, business managers from local support organizations, regional firms, technology transfer centres, spin-off companies and academics from universities in the North East of England.

The research findings suggest that while recognizing the significance of its strategic thinking, the strategic intention of Triple Helix for knowledge-based innovation has been challenged from a number of perspectives during the process of implementation. First, the cooperative relations of university-government-industry remain fragmented due to



diverse self-interests and different perceptions of the roles performed by innovation actors. Second, the loosely coupled partnership relations between university-government-industry created confusion at different levels in coordinating and leading projects related to knowledge creation. Furthermore, the Triple Helix is also challenged by the pre-conditions such as institutional norms and culture gaps between university and industry, originating from the historical context of the region, which have hindered the development of new ideas and innovation. Finally, despite limited evidence of academics, business managers and government officials interacting across institutional boundaries and learning each other's roles, the effectiveness of such interactions for knowledge creation is still strongly affected by their traditional roles and institutional values.

Triple Helix, as a heuristic concept emerging from the dynamic knowledge economy, has certainly offered strategic value that reinforces the understanding of the importance of university-government-industry relations in generating knowledge-based innovation. However, empirical evidence from the research indicates that the totality of the Triple Helix concept is facing challenges in practice and needs to be further validated in a much wider context. The distinctiveness of this research lies in contributing to the existing theories of Triple Helix by highlighting the importance of redefining the strategic intentions and roles of key actors in building up knowledge-based innovation. The research findings also have significant implications for government policy makers, business practitioners and university academics when addressing the existing deficiencies in the implementation of knowledge-based innovation strategies in the regions. This may enable innovation actors to think beyond Triple Helix, taking into consideration the pre-conditions, institutional dynamics and complex networking processes for the success of knowledge-based innovation. Future research is suggested to investigate Triple Helix networks during the implementation of the new knowledge-based initiative - Science City in the North East of England.

### **Key Words:**

Triple Helix, Knowledge-based Innovation, Knowledge Sharing, Regional Innovation Networks

## **Acknowledgements**

The research journey towards a Doctoral degree is truly a testimony to the indefatigable nature of human spirit. This work is dedicated to all who advise and help the ongoing process of learning. As ever, my heartfelt thanks go to my supervisor Professor Ian McLoughlin, for his great patience and time to my efforts and invaluable guidance and support throughout the research journey. I am also particularly indebted to Professor David Charles for his valuable comments on the research project. Special thanks also go to colleagues in the Newcastle University Business School which provides a stimulating and supportive environment for my conducting research activities. I should acknowledge substantial contributions of all research participants who agreed to be interviewed and gave their time to have frank exchanges on relevant issues are acknowledged.

I would like to record my sincere thanks to Dr Alison Hardy and Dr. Richard Li-Hua for their valuable comments to the arguments and philosophy of the study.

Last but not least, a special thank word for my parents for their accompanying during the long process of research.

## **List of Figures**

- Figure 1.1 Triple Helix Model of University-Government-Industry Relations
- Figure 3.1 The Philosophical Notion of the Case Study Strategy
- Figure 3.2 A Demonstration of Case Study Design
- Figure 4.1 Regional Economic Strategy & Strategy for Success Initiative
- Figure 4.2 Organizational Structure of Strategy for Success Networks
- Figure 4.3 The Strategy for Success Innovation Networks
- Figure 5.1 Inward Investor Target Model
- Figure 5.2 Inward Investment Innovation Networks
- Figure 5.3 Current Communications within the Inward Investment Networks
- Figure 5.4 Communication Channels Expected by Network Managers
- Figure 6.1 The Engagement Mode of Centre of Excellence: CENAMPS
- Figure 6.2 The Engagement Mode of Centre of Excellence: NaREC
- Figure 6.3 The Engagement Mode of Centre of Excellence: CodeWorks
- Figure 6.4 The Engagement Mode of Centre of Excellence: CPI
- Figure 5.5 The Engagement Mode of Centre of Excellence: CELS
- Figure 7.1a The Strategic Intention of Triple Helix
- Figure 7.1b The Reality of Triple Helix
- Figure 7.2 The Effective Model of Triple Helix in the North East of England
- Figure 7.3 The Broker Role of Centre of Excellence
- Figure 7.4 A Strategic Framework of Implementing Triple Helix model of Knowledge-based Innovation in a Regional Context
- Figure 8.1 The Three Pillars and Regional Strategy for Success
- Figure 8.2 The Science City Initiative

## **List of Tables**

Table 3.1	Case Study and Research Focus
Table 3.2	An Illustration of Research Process
Table 3.3	The Profile and Roles of Interviewees
Table 5.1	Invisible factors within the Innovation Networks
Table 7.1	Managing learning in the Regional Innovation Networks

## **List of Abbreviations**

KBI	Knowledge-based Innovation
NIS	National Innovation System
RIS	Regional Innovation System
TH	Triple Helix
SfS	Strategy for Success
SIC	Science & Industry Council
CoEs	Centre of Excellences
CENAMPS	Centre of Nanotechnology, Microsystems and Photonics
NaREC	Centre for New and Renewable Energy
CPI	Centre for Process Industry Innovation
CELS	Centre of Excellence in Life Science
CodeWorks	Centre of Digital Technology & Media
RCN	Regional Cluster Networks
TTO	Technology Transfer Office
KTP	Knowledge Transfer Partners
IIN	Inward Investment Networks
IIT	Inward Investment Team
SRP	Sub-regional Partners
RDA	Regional Development Agency

# **Introduction**

This thesis evaluate and examines the process of creating knowledge-based innovation in a regional context, with a special interest in how innovation capacities are generated through the successful implementation of Triple Helix relations of university-government-industry, which is regarded as a heuristic model and guidance for innovation policy making. The opening chapter aims to set the scene and contextualize the research concerning the development of new innovation paradigm in the knowledge economy. It will begin with the research problems identified in the context of knowledge-based innovation, followed by the rationale and focus of the research as well as the aims and objectives.

A summary of the research strategy and methods of data collection will be provided and an overview of the significance of the current project and its key contributions will be highlighted in line with the aims and objectives of the current research. Finally the chapter will finish by outlining the structure of the thesis.

## **I Statement of Problem and Context**

### **The Strategic Context of Knowledge-based Innovation**

Innovation has been widely acknowledged as the central element of economic performance and competitiveness with knowledge being the key ingredient of innovation. As a result, increasing attention has been paid to how to create and diffuse knowledge, particularly in knowledge-intensive industries. Many have claimed that this is now the age of the knowledge economy (Robertson D., 1999, Adler P. S., 2001, Thompson, 2004, Smith, 2000, Bryson J R and Daniels P W and Henry N D and Pollard J., 2000). However, the meaning and definition of "knowledge economy" remains vague and controversial. Nonetheless, the term as a theoretical concept has been widely-used by policy makers, academics and business practitioners.

One of the important themes emerging from the knowledge economy literature is how innovation capacities are generated through successful knowledge creation and diffusion. Various empirical research projects and observations attempting to tackle this issue have formed the basis of the theoretical concept of 'knowledge-based innovation' and the broad strategic context in which the concept is continuously

explored, developed and analyzed. Among the burgeoning literature on innovation and the knowledge economy, there are four main building blocks underlying the trends and development of knowledge-based innovation.

Firstly, it is widely accepted that knowledge is now playing a significant role in many aspects of our society through contributing to production, human capital and economic growth. The importance of knowledge as the key sources of competitive advantage in a knowledge economy has changed the way businesses compete (World Bank 1998). The new economic development is seen as an outcome of the new combination, i.e. making use of new knowledge, or making use of the knowledge in a new way. The importance of knowledge is evidence from various policy programmes in supporting the movement to the knowledge economy, increasing the demand for industry to develop new knowledge in order to sustain its competitive advantage in the turbulent global business environment.

Secondly, Innovation through networks has become a key feature of the knowledge-based economy with the rise of new production of knowledge (Gibbons et al., 1994), which is focused on the application of knowledge in the real business context. It is argued that the development of new knowledge no longer comes from an individual discipline, but from a multi-disciplinary context. Extended from this view is the engagement of science and technology research with industries, in particular the role of the university, which is regarded as the 'stock of knowledge' in the process of new knowledge production. The main issues include university-industrial interactions (Charles and Benneworth, 2001, Inzelt, 2004), the role of the university in the transmission of knowledge (Lambooy J., 2004) and economic development (Gorrdard J., 1997, Varga, 2000).

Innovation through networking is also linked to other conceptual frameworks concerning knowledge generation and application. For instance, the cluster theory focuses on industrial linkages and inter-firm interactions to generate new knowledge (Andriani et al., 2005, Huggins, 1998, Maskell, 2001); the system of innovation approach argues the importance of networks of institutions in shaping the innovation context from a policy perspective (Lopez-Martinez R.E. and Piccaluga A., 2000b, Mothe dela and Paquet, 2000, Patel and Pavitt, 1994, Biemans W., 1992, Pittaway et

al., 2004). In addition to the diverse approach of analyzing innovation networks, the subject itself as a process also attracts the attention of sociologists and organizational theorists in exploring the emerging knowledge networks involved in the innovation process in a number of high-tech industries (Howell., 1996, Gemunden et al., 1996, Collinson, 2000, Owen-Smith and Powell, 2004). However, this work is challenged by other scholars who argue that the content of knowledge differs with various scientific requirements, thus the validity of the findings across different industries in developing innovation capacities needs to be closely examined (Smith-Lawton, 2000, Rothwell, 1992). Despite the significance of the findings identified from the empirical studies, to what extent these results underpin the claim of the existence of the knowledge economy remains unclear.

Thirdly, it is claimed that the changes involved in creating the knowledge economy have brought new challenges for innovation. The nature of the change is both dynamic and transformational (DTI., 2002, Inzelt, 2004). The effects of the changes in particular are manifest in two aspects: (1) The increase of government innovation policy in addressing the importance of knowledge creation through collaborations between research institutions and industry (Preuss and Oxford Brookes University. School of Planning., 2002). (2) The changing role of traditional institutions during the process of innovation. These changes have led to, for example, the emerging business-like entrepreneurial university (Benneworth, 2001) (Benneworth, 2001), research-oriented firms and government acting as public entrepreneur and venture capitalist (Etzkowitz and De Mello, 2003, Etzkowitz, 2003, Etzkowitz H. and Leydesdorff L., 2001).

Finally, The emergence of high performance region based on effective knowledge-based innovation has been increasingly invoked as a factor to explain the transition towards the knowledge economy (Saxenian A., 2000, Castilla E. and Hwang H. and Granovetter E. and Granovetter M., 2000, Brown and Duguid, 2002, Gordon and Kimball, 1998). Consequently, there has been growing interest in examining the regional configuration of knowledge-based innovation and the impact of regional innovation system in shaping the process of knowledge generation and diffusion (Camagni R., 1991, Wiig and Wood, 1997, Morgan and Nauwelaers, 1999, Cooke, 1998b, Cooke, 2001). For instance, Mailat (1994) points out the territorial dynamics



of innovation, Denyer (2004) explores regional innovation from the UK perspective, and Todtling (1999) compares regional innovation networks across European countries.

On the one hand, these studies highlight the importance of regions in generating new knowledge by creating knowledge infrastructures to enhance information flow through regional innovation networks (Kogut et al., 1993, Smith-Lawton, 2000). On the other hand, there has been a lack of consensus on how innovation capacities can be generated through the cooperation and interactions of key elements within the innovation system. It is argued that due to the dynamic process of knowledge creation, firms are still facing significant barriers to innovation in the regional context (Frenkel, 2003)

The claims and arguments sketched above clearly indicate that the meaning of knowledge-based innovation rests on different conceptual frameworks and empirical support from different perspectives. Although each perspective has its own strengths and values, there has not been a coherent approach which helps to explore and understand the dynamic issues and critical problems emerging from the strategic context of knowledge-based innovation. In particular, the ideas and theoretical assumptions made in the existing literature need to be assessed and examined and the implications of the linkages of these theories need to be considered within the appropriate context.

### **The Regional focus of Knowledge-based Innovation**

The importance of regional configurations in knowledge-creation has been widely acknowledged by economists and innovation theorists. With the introduction of new production of knowledge (Gibbons et al, 1994), the knowledge economy (OECD, 1996), clusters and networks (Cantwell, 1999, Enright, 1995), national and regional systems of innovation (Lundvall B. -A., 1992, Cooke P., 1998, Nelson, 2000) , and the learning region (Florida R., 1995, Florida R., 2000), the traditional approach of innovation based on productive forces within industries has been challenged by the demand of collective knowledge through close interaction and collaboration across organizational boundaries.

The ability to identify and connect with key components within the innovation system is seen as crucial for generating new knowledge and innovation capacities, as knowledge creation needs proximity, close interaction and relationship building between innovation actors (Cooke, 2004). Empirical evidence also suggests that one of the key features of the success of the innovative regions is that there is strong evidence of cooperative relations and interactive networks between innovation actors within regions such as Silicon Valley, the Italianate variant of Marshallian Industrial districts (see (Castilla E. and Hwang H. and Granovetter E. and Granovetter M., 2000, Cohen and Fields, 1999, Brown and Duguid, 2002, Saxenian A., 2000). These interactive networks not only involve firms, but also research institutions such as universities and local government, thereby creating the knowledge infrastructure and institutional arrangement that facilitate collective action for knowledge generation and diffusion.

However, empirical evidence from regions and clusters that have been successful with knowledge-based innovation shows that the process of knowledge generation and diffusion is underpinned by the diverse interests and roles of innovation actors, different innovation processes by key actors, and the effect that these processes have in developing different patterns of communication and interaction. These variations therefore result in different applications of knowledge-based innovation in different geographical territories.

For policy makers, economists and innovation theorists, the key concern emerging from the high performance regions is obvious: how knowledge-based innovation can be developed in other geographical areas and particular less-developed regions? Based on empirical investigations and observations on the practice of high performance regions, the Triple Helix concept, as a heuristic framework, offers a strategic view of generating innovation capacities through strengthening university-government-industry interaction and collaboration.

### **The Triple Helix model of Knowledge-based Innovation**

The recognition of collective action and networks across organizational and institutional boundaries for knowledge creation has challenged the classic focus on

productive forces for economic growth and innovation studies based on single companies and industries. The importance of collective knowledge and learning (Castells M., 2000, Castells M., 1996) and the trend of new knowledge production (Gibbons, et al. 1994) have pointed to the need for a new way of innovation which has been increasingly focused on the collaboration between university, government and industry. The concept of Triple Helix (TH) has been invoked as an important expression of collaboration networks between university-government-industry ((Etzkowitz, 2002, Etzkowitz and De Mello, 2003, Etzkowitz H. and Leydesdorff L., 2001, Leydesdorff, 2000, Leydesdorff, 2001, Rodrigues and Esteves, 2000, Saad, 2004, Sutz J., 2001, Baber, 2001).

Based on empirical observation and research on high performance regions, the Triple Helix captures the key nature of the innovative region which is based on the cooperative relations and interactions between university, government and industry. It is argued that a dynamic helix pattern of connections between three spheres - university, government and industry - evolves over time. New knowledge is generated through the interactions of the three spheres and changes occur in each of the spheres, such as technology transfer between university and industry, government support for new innovation programmes, universities developing entrepreneurial strategies, etc. (Etzkowitz and Leydesdorff, 2001). During the process of interaction, networks are established and mutual expectations are adjusted and adapted for cooperation.

It is argued that the Triple Helix not only mirrors transformational relationships of university, government and industry, but also denotes the internal transformation within each of these spheres during the process of interaction (Leydesdorff and Etzkowitz, 1998) for new knowledge production. Although many theoretical propositions presented from the concept are still open to further testing and debate, the Triple Helix, as an analytical framework and a policy guide for investigating the dynamics and changes involved in creating knowledge-based innovation, has generated growing interest among academics.

The TH concept is rhetorically powerful, however the theoretical base of the concept is rather vague and there is little evidence on how the purpose, function and consequences of TH are successfully achieved outside the limited number of well-

known high performance regions (Shinn, 2002). Given the increasing attention paid to the development of knowledge-based innovation in regions (Asheim and Coenen, 2005, Heidenreich M., 1998, Cooke, 2001), the key question is: can knowledge-based innovation in regions be designed through the creation of cooperation networks between university, government and industry, or is it evolved from the historical and institutional context of regions? In other word, are TH networks a driving force for developing knowledge-based innovation, or simply a feature of the high performance region which have been identified in the successful knowledge economy? In addition, it is argued that despite the positive narratives of the framework, evidence for the effectiveness of Triple Helix cooperation has been questioned, particularly in less developed regions (Jensen and Trgrdh, 2004).

In addition, if the TH is regarded as a key driver for knowledge-based innovation, questions such as how innovation actors are motivated by self interest to interact for knowledge creation, how the mutual expectations of actors are adjusted and changed by creating the cooperation relationships, and to what extent the pre-conditions of the region have an effect on the transformational change to the new patterns of innovation networks, ought to be further investigated. Furthermore, though the importance of interactions and networks have been widely addressed in the literature on innovation, as Morgan and Nauwelaers (2003) point out, it is not that less developed region lack networks per se; what they lack is dynamic networks which facilitate learning and innovation rather than networks which reflect and protect the status quo and thereby foreclose the possibilities for change and development. How collective learning occurs during the process of knowledge creation needs to be understood.

In summary, a review of the literature on the strategic context of knowledge-based innovation reveals a number of significant research gaps which need to be properly and appropriately addressed. In particular, the strategic insights of the conceptual framework presented by the TH need to be critically tested and examined through further empirical research in a different regional context. It is the conceptual gaps identified above that have inspired the philosophy of the current study and at the same time has sustained the rationale and the justification of the research.

## **II Research Focus and Rationale**

Based on the strategic context of knowledge-based innovation, the primary aim of the current study is to investigate how innovation capacities are generated through successful implementation of Triple Helix relations of university-government-industry. The theoretical focus of the research is twofold:

First, the interactive nature of knowledge-based innovation emphasized in the TH model implies the importance of processes of collective actions and learning between the key players at the heart of the knowledge economy. Therefore the orientation of this research is not limited to individual research institutions, or companies conducting innovation activities taking place in the technological forefront. Instead, the research is centred on the analysis of social and organizational networks and processes of interaction between identified innovation actors that lead to the creation of successful knowledge-based innovation.

Second, it is recognized that the significant gap in the TH concept lies in its lack of practice and empirical evidence that can better elaborate the arguments and theories. Therefore the research will focus on the micro-level and implementation process of TH. It is argued that traditional innovation policy tends to be measured either by economic indicators or formal R&D and IPR (intellectual property rights) generated, while the social and organizational dimension has been underestimated in the evaluation of innovation policy (Sanchez, 2000). In this sense, the implementation perspective will advance understanding of how the strategic intention of TH for developing knowledge-based innovation is translated into practice and how the innovation activities are performed at operational and individual level. It will also help to identify problems and challenges facing innovation actors in the process of interaction and offer pragmatic suggestions for further improvement of innovation practice. As O'Brien (2000) points out, the knowledge based economy is not about making everyone an expert in nuclear physics or nanotechnology, but about strategically accessing and rapidly applying the 'know-how' of knowledge-based communities.

The empirical focus in this research based in the North East of England, is to identify

the process whereby has a less developed region generates innovation capacities through implementing a knowledge-based innovation strategy. The focus on a less-developed region will give more room to further examine the research gaps identified in the TH model and to analyze the effectiveness of TH in generating innovation capacities in a less developed region.

The empirical data collected from this research will be explained and analyzed in line with the theoretical narratives presented in the TH model, and other theoretical issues will be addressed in relation to the process of innovation.

It can be argued that the TH concept might not be wide enough to encompass all the variables that are likely to be important for developing knowledge-based innovation; within the context and scope of this research, however, the concept has certainly offered enough of a common platform on which key conceptual issues that underpin the development of knowledge-based innovation in a regional context can be explored, interpreted and discussed.

### **III Research Aims & Objectives**

The principal aim of this thesis is to evaluate and examine the process of creating knowledge-based innovation in a less developed region from the perspective of TH relations of university-government-industry. For the purpose of conducting empirical research and achieving the research aim, a number of practical objectives have been developed as shown below:

<b>Objective 1</b>	To establish a theoretical framework for implementing knowledge-based innovation by critically evaluating and examining the propositions of Triple Helix.
<b>Objective 2</b>	To identify the nature and process of regional innovation through a pilot study.
<b>Objective 3</b>	To examine the effectiveness of implementing the Triple Helix model of knowledge-based innovation through the main study.

<b>Objective 4</b>	To establish a conceptual model for developing knowledge-based innovation at the regional level based upon the critical analysis and synthesis of research findings.
--------------------	--

#### **IV Research Strategy**

The nature of the study, which is focused on the process of innovation, means that a case study with an interpretive stance is deemed to be the most appropriate research strategy for accomplishing the research project and fulfilling the research objectives and aims.

The process of conducting the case study involved a wide range of data collection methods including desk research on government websites and publications, reports, newsletters, presentations, semi-structured interviews, direct observations through attendance at events organized by the government agencies, informal conversations with participants, keeping field notes, etc. Data analysis was conducted in conjunction with the data collection (Glaser B. and Strauss A., 1967). The analysis of data was undertaken using primarily inductive techniques (Eisenhardt, 1989, Glaser B. and Strauss A., 1967, Marshall J., 1981, Strauss A. and Corbin J., 1990, Yin R.K., 1994). Data were organized around certain topics, key themes and central questions.

It needs to be pointed out that the purpose of the research is not to make any statistical generalization. As Yin (1984) and Harley (1994) argue, the generalization for case study is not about population, but relying on the ability to make analytical generalizations. Therefore the design of the case study and process of conducting the current research project does not intend to generalize the case study based on a single regional practice, but to reveal micro processes of knowledge-based innovation and thus to identify the critical issues underpinning the success of knowledge generation and diffusion in a regional context. The interpretative approach of a case study allows a flow of information in which new elements of knowledge can be generated. Finally, the longitudinal case study helps the researcher to collect evidences on the process of changes and to gain insights on how innovation evolves and develops over time.

## **V Original Contribution to knowledge**

The significance of the current research lies in its potential for understanding the dynamic and complex process of creating knowledge-based innovation to develop economic growth. The research will contribute to the discourse on knowledge-based innovation through critically examining and addressing the conceptual limits of the TH model for knowledge generation and diffusion. The findings of the research show that the implementation of the strategic intention of the TH model needs to take into account the specific regional context emerging from the dynamic interests and roles of innovation actors as well as the pre-conditions for its/their application.

The results of the study also have broad implications for government policy makers, business practitioners and university researchers when addressing the deficiencies of existing regional innovation systems and developing an effective knowledge-based innovation strategy. This will also enable innovation actors and managers to think beyond Triple Helix with an appreciation of the dynamic process of networking for success in creating knowledge-based innovation.

## **VI Structure of the Thesis**

The title of the thesis - Beyond Triple Helix: Examining the Implementation of Knowledge-based Innovation in the North East of England - highlights the focuses of the thesis and the need to examine the process of developing successful knowledge-based innovation in the regional context. The structure of the thesis is presented in figure I.

There are eight working chapters in this thesis and a separate document containing the design of the case study questions in the Appendix. This introductory chapter provides a summary statement of the research problem and the purpose of the research. The thesis is then organized as follows:



## Structure of the Thesis

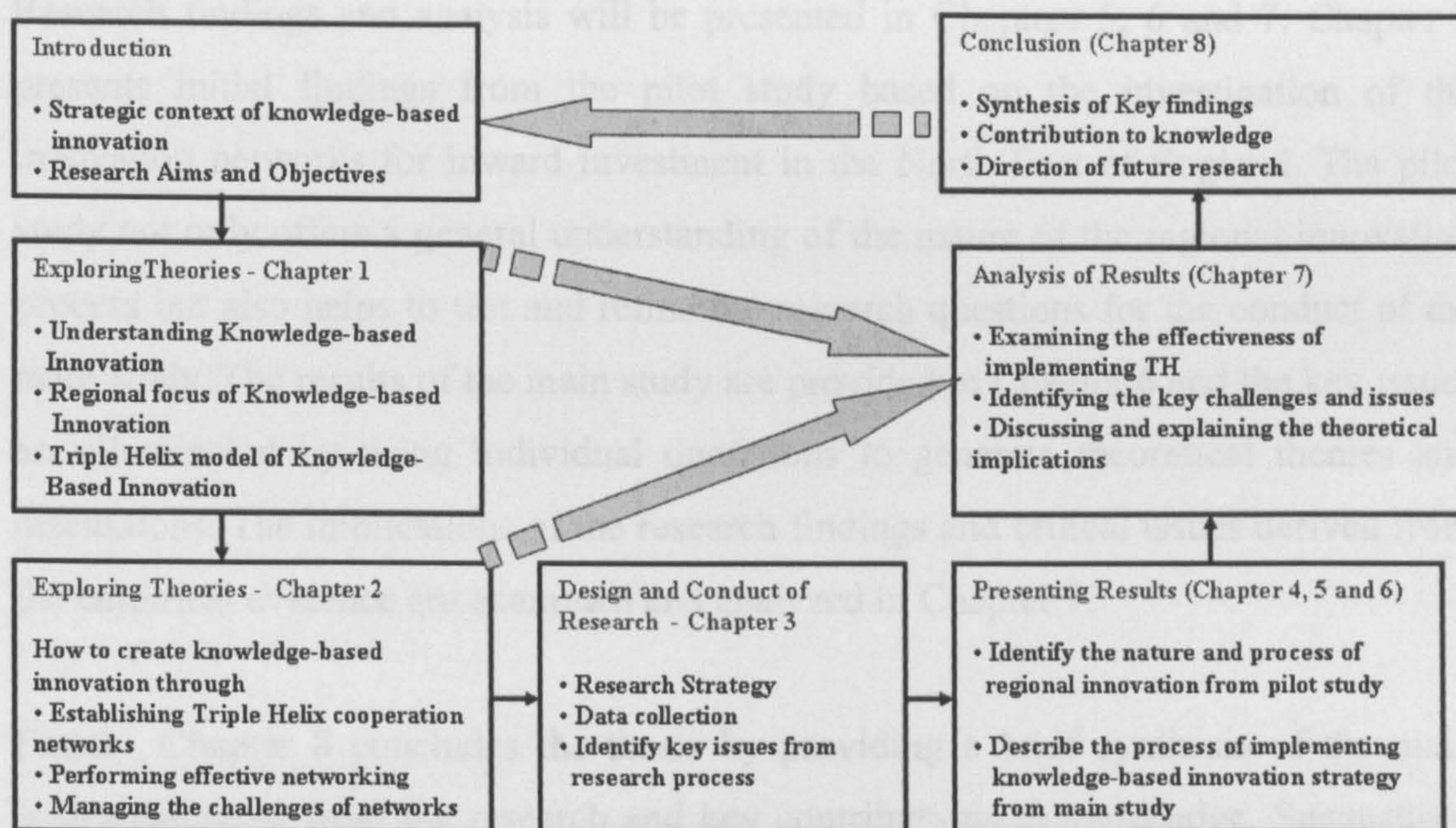


Figure I: the structure of the thesis

A comprehensive literature review is provided in Chapters 1 and 2. Chapter 1 set the stage and developed a conceptual framework for the study of the knowledge-based innovation in a regional context through critically reviewing the history and development of innovation and the problems of knowledge creation faced by organizations operating in the knowledge economy. Triple Helix was introduced and critically reviewed as an up-to-date heuristic concept for understanding the contemporary phenomenon of knowledge-based innovation. Chapter 2 further examines the TH concept from the implementation perspective at micro-level and provides a conceptual framework to explain how the strategic intention of TH can be implemented in practice through effective networking.

Chapter 3 presents the research methodology adopted in this study, including details of the research process, theoretical underpinnings as well as philosophical notions of the research, the rationale of the research design and data collection methods. Criticisms on the limitations of the research methodology are also noted and highlighted at the end. Following the research methodology, Chapter 4 provides the strategic background of the case and the development of innovation in the North East of England, which form an essential part of the context of implementing knowledge-based innovation.

Research findings and analysis will be presented in Chapters 5, 6 and 7. Chapter 5 presents initial findings from the pilot study based on the investigation of the innovation networks for inward investment in the North East of England. The pilot study not only offers a general understanding of the nature of the regional innovation process but also helps to test and refine the research questions for the conduct of the main study. The results of the main study are provided in Chapter 6 and the key issues are illuminated by using individual quotations to generate theoretical themes and discussions. The implications of the research findings and critical issues derived from the empirical evidence are examined and analyzed in Chapter 7.

Finally, Chapter 8 concludes the thesis by providing a brief synthesis of the main issues emerging from the research and key contributions to knowledge. Suggestions for the future direction of research and potential research focus are also included.

# **Chapter 1 Strategic Context of Knowledge-based Innovation**

## **1.1 Introduction**

Knowledge generation and diffusion have been regarded as key of gaining competitive advantages in the turbulent global business environment. The relationship between firm's success, innovation and knowledge economy has been explored in the various academic literatures (Malecki E.J., 2000, Cooke P and Morgan K., 1998, Nooteboom, 1999). How to generate new knowledge through effective innovation has become the key agenda for government policy makers as well as business organizations.

The purpose of this chapter is to explore and understand the strategic context of knowledge-based innovation (KBI) by identifying and critically reviewing the key models of KBI which underpins theoretical assumptions from three perspectives:

- Understanding knowledge-based innovation
- Regional focus of knowledge-based innovation;
- Triple Helix mode of knowledge-based innovation

First, innovation is defined and understood in different ways. It is increasingly recognized that innovation takes between organizations rather than within single firm. A brief review of the key models of innovation will be provided and the meaning of knowledge-based innovation in this research will be explained in line with the challenges imposed by the development of knowledge economy.

Second, the recognition for developing proximity relations and interactions between firms, and firms with the surrounding institutional networks for knowledge generation and diffusion has brought about region at the centre of studying knowledge-based innovation. The importance of region as the arena for creating KBI will be explored and discussed.

Finally, the concept of Triple Helix will be introduced as an important framework of analyzing the mechanism and dynamics of KBI. In stead of viewing innovation driven

from a particular institutional sphere, i.e. industry, university or government, the idea of Triple Helix mirrors the transformational relations between university-government-industry in building up innovation capacity through cooperative networks and continuous interactions. The key theoretical assumptions and conceptual issues of Triple Helix will be critically examined in the current study.

The Chapter will conclude by highlighting thematic focus of the research based on the critical review of the strategic context of KBI.

## **1.2 Understanding Knowledge-based Innovation**

### **1.2.1 Defining Innovation**

The study of innovation has evolved significantly over the last decade. Despite of numerous literature of innovation, it is hard to identify the common theoretical basis for innovation research (Drazin and Schoonhoven, 1996).

According to the Oxford dictionary, innovation means introduction of new things, ideas or ways of doing something. Innovation is often linked to invention in the sense of the first occurrence of the ideas. Fergaberg (2005) points out that an important distinction should be made between invention and innovation although the two concepts are closely linked. For instance, it is argued that while invention is the first occurrence of an idea for new product or process, innovation denotes the first attempt to carry it into practice. Similar view is also expressed by Mulkey (1972) who pointed out that innovation is seen the creation of new ideas, or about the diffusion of ideas and their subsequent appropriation into society (Mulkey, 1972).

In addition, to be able to turn an invention into an innovation, a firm needs to combine several types of knowledge, capabilities, skills and resources. What's more, even equipped with the necessary knowledge and resources, the conditions for innovation may be lacking which causes further time lags. Such conditions may have to rely on new inventions and subsequent commercialization in order to create the conditions for innovation. As Fergaberg (2005) indicates that what we think of as a single innovation is often a result of a lengthy process involving many interrelated innovations. It is the processual nature of innovation which creates significant challenges for organizations to develop a system approach on how to manage the process of continuous

improvement.

The analysis of the definition of innovation reveals the following elements that consists the essence of innovation studies:

- Invention
- Practice
- Organizations
- Knowledge /skills
- Resources

If one accept that innovation doesn't not only denote some thing new, but also links to practice and actions embodied either within or across organizations through acquiring new knowledge, developing different skills and allocating and combining a wide range of resources, it is not surprising that the challenges facing all organizations striving for gaining competitive advantages based on successful innovation are significant in the fast changing global environment.

The examination of existing literature identifies that innovation is classified in different types including product innovation, new sources of supply, the exploitation of market, new ways to organize process etc. Most economists have been concentrating on the product and process innovation based on the assumption that the impact of the two types of innovation on society is different (Schumpeter, 1966) Edquist et.al (2001) further suggest dividing the process innovation into technological process innovation and organizational process innovations. The former is related to the new types of technology and the later to new ways of working. It is argued that although the focus on product and process innovation are useful for the analysis of some issues, they should not lead us ignore other aspects of innovation. In addition, despite of clearly distinguishes between product and process innovation at the level of the individual firm or industry, such differences tend to become blurred at the level of the overall economy(Fagerberg et al., 2005).

The function and role of innovation played in the economic and social change has no doubt been widely acknowledged by economists and governments ((Nooteboom, 2000, Simmie, 2004, DTI., 2002, OECD;, 2000). The core assumption of these

arguments is that innovation is one of key sources for firms to develop new business opportunities and enhance organizational performance, hence leads to the economic growth. Innovation is the renewal and enlargement of the range of products and services and the associated markets; the establishment of new methods of production, supply and distribution; the introduction of changes in management, work organization, and the working conditions and skills of the workforce (European Commission, 1995). Although the relationships between technological, organizational and institutional changes and the associated policy discourse continuous to be an important agenda, the implications for studying how innovation occur and diffuse in within and across organizations, industries and nations are significant. Thus, what needs to be understood about innovation, according to Fagerberg (2005) are:

- ‘The function of innovation is to introduce novelty (variety) into the economic sphere. Should the stream of novelty (innovation) dry up, the economy will settle into a ‘stationary state’ with little or no growth (Metcalf, 1998)’
- ‘Innovation tends to cluster in certain industries/sectors, which consequently grow more rapidly, implying structural changes in production and demand and, eventually, organizational and institutional change. The capacity to undertake the latter is important for the ability to create and to benefit from innovation.’
- ‘Innovation is a powerful explanatory factor behind differences in performance between firms, regions and countries. Firms that succeed in innovation prosper at the expense of their less able competitors. Innovative countries and regions have higher productivity and income than the less innovative ones. Countries, regions that wish to catch up with the innovation leaders face the challenge of increasing their own innovation activity (and ‘absorptive capacity’) towards leader levels’.

No matter what definition adopted by the government, innovation theorists, economists and firms, the fundamental question facing innovation actors is how innovation occur and how to manage the diffusion of innovation. It is pointed out that our understanding of innovation – the commercial exploitation of ideas and new

knowledge remains relatively limited (Wolfe, 1994)

Thus leaving definitions aside, studying innovation points to the needs of analyzing innovation as an evolving process rather than something exist already. The study of developing innovation has gone through different stages of development:

The first stage is based on the classic science push model, or the so-called linear-approach of innovation, which is driven by the assumption that innovation is an outcome of scientific inventions by isolated academics. The model assumes that scientific research would generate new knowledge and the results will be picked up by firms and entrepreneur to develop new product that is applied into the market. Consequently, the process of innovation is that starting with research, then moves to design and production for the market, then onto marketing and consumer. The theory underpinning this approach is based on the market which is stable and predictable. Thus innovation policy is geared towards supporting research (European Commissions, 2002) based on the simplified process of innovation. Notwithstanding the significant role of science in new knowledge creation, it is argued that the role of basic science is exaggerated in developing effective innovation. Innovation was thus portrayed as an activity of 'heroic individual' through the related stages of invention and diffusion (Schumpeter, 1943) and is being reduced to routine, which could be strictly calculated and well-defined act (Cooke P and Morgan K., 1998). What's more, the model fails to appreciate continuous interaction and feedback from the costumer who are engaged in the innovation process, thus enhancing the diffusion of innovation (Aoki and Rosenberg, 1987, Kline and Rosenberg, 1986).

Having recognized the needs for engaging business in the process of innovation, the second stage - Market-pull approach emphasizes the input of industry in providing information on application of new knowledge to ensure the success of commercialization (Myers and Marquis, 1969). The information may include product design, production and marketing trends. The key nature of second generation of innovation is that innovation is undertaken through several teams (technical, non-technical) working together and it is rarely a matter of heroic individual activities. The participants of innovation not only involve scientific researchers, but also engineers and business managers from the firm. It is argued that in this way information is

shared in two ways and it also helps to develop new knowledge and skills.

With the development of globalization and changing economic context, increasing attention has been paid on the content of innovation activities and roles played by actors involved in the process of innovation. For instance, the role of industry in generating innovation capacities is addressed in Porter's work – 'Competitive Advantages', which explores how to create industrial competitive advantages and productivities (Porter, 1985, Porter M. E., 1990). How firms conduct R&D and develop new product therefore becomes the key research agenda for many innovation theorists and business practitioners (Frenkel, 2003, Porter, 1985, Edwards et al., 2004). In the meanwhile, the external orientation of university academics in participating innovation projects within industries (Gulbrandsen and Smeby, 2002) and role of research institution such as university played in the innovation process have been paid growing attention by innovation researchers (Robertson D., 1999).

Review on the development of innovation clearly indicates that the concept of innovation has been understood and defined from different angles and supported by a diverse of theoretical frameworks. It is either considered as a discrete development resulting from scientific studies carried out by isolated academics and researchers in the universities or industrial based R&D activities for developing productivities and competitive advantages. However, there has been lack of systematic understanding on the inter-links of innovation activities conducted by actors from different organizational context and the effect that institutional arrangement and context of operation have on the generation of innovation capacities. Whilst R&D activities are certainly one of the key sources for innovation, other sources such as skilled personnel, learning by doing, collaboration and interactions through networks should not be ignored. Therefore, the orientation of studying innovation in this research is not limited to activities within a single firm or industry, or research in advanced technology, but focused on processes of collective actions in which diverse resources from a wide range of innovation actors are assembled and shared for knowledge generation and diffusion.



## **1.2.2 Innovation as Collective Actions**

One of the central themes of innovation literature is that innovation does not happen in isolation, but depends on extensive interactions with and between actors. Innovation as collective actions of a wide range of actors has been highlighted within a number of theories, among which the system approach of innovation and the social network theory play a fundamental role in terms of analyzing the relationships between innovation actors and the process of interactions from institutional and operational perspectives.

### **1.2.2.1 System Approach of Innovation**

Based on evolutionary and institutional theory (Dosi G., 1988, Edquist and Johnson, 1997), the “national innovation systems” (NIS) was introduced to innovation research in the 1980s to emphasize the important role played by the specific national institutional settings and non-economic actors for the innovative performance of an economic system (Ahrweiler P. and Gilbert N. and Pyka A., 2005, Freeman C., 1987, Nelson, 2000, Lopez-Martinez R.E. and Piccaluga A., 2000a). System means that a set of institutional actors interact with each other and play the major role in motivate and influence innovation performance.

Beije (1998) defines an innovation system as a group of private firms, public research institutes, and several of the facilitators of innovation, who in interaction promote the creation of one or a number of technological innovations (within a framework of) institutions which promote or facilitate the diffusion or application of these technological innovations.

The rising of NIS is, in part, associated with the tendency towards internationalization of trade, capital, technology and production during the post-1945. These general concerns with competition and performance have motivated economists, managers and policy analysts for many years (Mothe dela and Paquet, 2000). In particular, the concept of NIS recognized that the central performance of technological change, capacities of innovation will depend on the way in which the available resources are managed and organized, both at the enterprise and at the national level (Freeman, 1993). The NIS approach focuses on the description of the organization and patterns

of activity that contribute to innovative behavior in specific countries and identifies those institutions and actors embedded in a distinguished national institutional infrastructure who play a decisive role in particular industries (Lundvall B. -A., 1992). Essentially, the notion of NIS emphasizes that firms are not alone in the developing innovation, instead, firms are innovating through networks of a wide range of institutions (public or private) whose activities and interactions are initiate, import, modify and diffuse new technologies (Mothe dela and Paquet, 2000).

The key argument of the system approach of innovation is that the innovation system is embedded in the links, set up and structures of institutions in the regional and national context. However, it is argued that having the structure in place might not be sufficient to achieve the successful innovation. What is more important is the capacity of innovation generated from the interactions between actors within the system (Furman et al., 2000, Furman et al., 2002).

#### **1.2.2.2 Social Network Approach of Innovation**

Another way of analyzing the collective nature of innovation is from the social and organizational level, in which social networks is seen essential in mobilizing collective actions of innovation actors. Social networks are regarded as important for acquiring information (Burt R.S., 1992), learning how to do one's work and solving complex problems (Hutchins 1991) and knowledge transfer (Levin and Cross, 2004). It is argued that social networks provide firms with a set of embedded resources in the form of access channels to knowledge inputs and opportunities (Burt R.S., 1992) and also in the form of culture and value based social relationships between actors.

In the context of pursuing collective action for innovation, resource-dependence theory explains that inter-dependency between innovation actors is the key for maintaining effective network relations. The inter-dependency lies in the need for sharing information (Boisot M., 1994), solving complex problem a and knowledge transfer. It is the inter-dependency that causes continuous interactions between actors which create and sustain patterns of relationships (Crozier M. and Friedberg E., 1980)

In addition to providing structural access to resources and forming social relations through networks, networks as a strategic conduct and action (Alliez, 1996;

(Harmaakorpi V. and Melkas H., 2005, Camagni R., 1991, Pratt, 1997) shed light on the importance of developing effective networks during the process of innovation. Network as 'conduct' or 'action' derives from the original meaning of networks which is regarded as an attempt to make links and develop relationships. It is argued that explicit network structures or relationships do not mean that they are dictated by one party or another (Miles R.E. and Snow C.C., 1992). Innovation through collective actions requires individual actor continuously developing, facilitating and coordinating innovation networks (Friend J.K. and Power J.M. and Yewlett C.J.L., 1974) to achieve their strategic agenda.

Despite different theoretical focus, what has emerged from system approach and social network of innovation is the importance of interactions and networks for knowledge creation, which is the key feature of knowledge-based innovation.

### **1.2.3 Knowledge-based Innovation**

The concept of knowledge-based innovation is driven by three main challenges imposed by the development of knowledge economy, knowledge-based competitiveness and the new production of knowledge.

#### **1.2.3.1 The Nature of Knowledge Economy**

Although the definition of knowledge is still under debate in various literatures, many claim that knowledge is now the primary source of wealth and key indicator of the economy (Robertson D., 1999, Smith, 2000, Shields R., 2000, Harris, 2001, ECDE 2004); Sveihy, 1997). Economists view knowledge economy is as "One that encourages its organizations and people to acquire, create, disseminate and use (codified and tacit) knowledge more effectively for greater economic and social development" (Baumard, 1999);Dahlman and Anderson, 2000). Surely there can be little question about the increasing importance of knowledge in the economy, or about its consequences for the way economic activity is organized or for the way policy-makers think about economic and industrial policy.

At a very basic level, it has been argued that the rate at which organizations acquire, create and effectively utilize knowledge to produce product and services will become the only sustainable competitive advantage for organizations to thrive in the rapidly

changing and unpredictable environment (Krogh Georg von and Roos Johan, 1996, Roos et al., 1998). Social capital, as an important feature of knowledge economy is also seen essential to support organizational learning and creation of new knowledge. The social exchange involved in generating innovation (Mulkey, 1972) is not something new. However, the knowledge economy which is featured by continuous knowledge creation and application has further enhanced the role of social capital which carries tacit knowledge and build upon continuous interactions and trust-based relationships (Cooke, 1998).

Despite various attempts in providing the key themes and indicators of knowledge economy, it is pointed out that this concept still needs to be properly understood and digested (O'Connor D; Shields R; Ilcan S; Taborsky E;, 2002). An unknown proportion of knowledge is implicit, uncodified and stored only in the minds of individuals. Terrain such as knowledge stocks and flows, knowledge distribution and the relation between creation and economic performance is still virtually mapped (OECD, 1996). It is acknowledged that the concept of knowledge economy, as a product of social-economic trends and political choice, should be viewed as an empirical hypothesis or as a political goal or vision (European Commissions, 2002) which is continuously evolving and changing over time rather than a fixed reality. What remains as the central debate in the knowledge economy is developing knowledge-based competitive strategies.

#### **1.2.3.2 Knowledge-based Competitiveness**

The development of globalization and changing economic context have shifted the traditional competitive notion of 'doing everything well yourself' towards a new notion of 'creating strategic and sustainable competitive advantages' (see Prahalad and Hamel 1990, Porter, 1985) based on successful knowledge creation and diffusion (Boekema et.al. 2000). At organizational level, the increasing importance of knowledge is changing the way firms compete and the sources of competitive advantages (World Bank 1998). In order to maintain the competitive advantages, firms must invest in creation of more sustainable advantages. This gradually leads to the materialization of a knowledge economy, where the competitive edge of many firms has shifted from static price competition towards dynamic improvement, favouring those who can create knowledge faster than competitors. The new growth

theory suggests that a society which arrange itself competently both in the creation of new ideas and their productive exploitation is a society which can renew itself and prosper (Gemmell, 1997).

From government perspective, facilitating and support knowledge-based activities have become the key agenda for gaining national competitive strategies. The new economic development, as noted by Schumpeter (1926), is the outcome of the new combinations, i.e. making use of new knowledge, or making use of the knowledge in new ways and in his view both types of knowledge creation contribute to innovation which in turn leads to economic development. Acknowledging the significance of developing knowledge-based competitive advantages requires due considerations given to the process of innovation that leads to successful knowledge generation and diffusion. It is pointed out that changes in the business environment and economic uncertainties have stimulated new business practices that calls for new production of knowledge.

### **1.2.3.3 The New Production of Knowledge**

Driven by the dynamic nature of knowledge economy, it is argued the new mode of knowledge production affects not only what knowledge is produced, but also how it is produced, the context in which it is produced, the way it is organized, the reward system it utilized and the mechanisms that control the quality of that which is produced (Gibbons et.al 1994). Thus the new production of knowledge is different from the traditional meaning of knowledge in a number of ways.

First of all, traditional production of knowledge tends to be generated within a disciplinary, primarily associated with scientific inventions. However in the changing economic context, the fast and dynamic changes in practice results in the need of developing new production of knowledge that can combine the complex needs and application of new knowledge. Secondly, traditional knowledge production is disciplinary and characterized by homogeneity. It is hierarchical and tends to preserve its form; Whereas new production of knowledge is transdisciplinary and characterized by heterogeneity. It is more hierarchical and transient. This means the production of new knowledge no longer occurs only inside disciplinary boundaries. It also occurs in the interstices between established disciplines, through the cross-fertilizations

between disciplinary areas, and through the diffusion of instruments and procedures which affect the practice of research in often remote areas.

Finally, while the traditional production of knowledge still remains important in developing specific disciplinary knowledge, new production of knowledge emerges along with traditional with new attributes in the context of knowledge economy. The fast changing business environment and increasing demand of customers, companies need to develop new product which can meet the complex needs of customers. Developing new product will require knowledge from a broader range of considerations rather than from a single perspective. Thus companies need to collaborate with other actors and incorporate various interests into the innovation networks in order to develop new knowledge.

The importance of generating knowledge-based competitive advantages through new ways of production forms the core element of knowledge-based innovation, in which knowledge is understood in a broad sense involves not only scientific knowledge, but also the learning generated in the process of innovation (Lundvall B-A. and Borrás S., 1997). The essential ingredient of knowledge-based innovation, as Gibbson et.al (1994) note that it is neither the science of the universities nor the technology of industry that drive the innovation process, rather it is the collective actions and interactions of a wide range of innovation actors through networks.

#### **1.2.4 Challenges of Knowledge-based Innovation**

Reviewing on exiting literature suggests that the success of developing knowledge-based innovation has been challenged in many ways due to dynamic nature of knowledge economy and the new way of knowledge production. Among the diverse issues that have been analyzed in relation to the creation of knowledge-based innovation, it is identified that innovation challenges for knowledge creation are from three main aspects: dynamic information processing; complex knowledge infrastructure and process of coordination.

#### **1.2.4.1 Dynamics of Information Processing**

The first challenge of developing knowledge-based innovation rests on the dynamics and diverse information in the knowledge economy as a result of the development of information and communication technologies. The capacity of developing innovation is now highly dependent on the ability of accessing information and knowledge (Huggins R., 1997). In the innovation process, access to accurate and up-to-date information has always been important. The evolution of information technology has made the exchange information much faster than ever before, thus reduced the cost of gathering and disseminating knowledge.

The richness of information has on one hand helped to provide a wide range of sources of innovation. On the other hand, it has brought about the challenges for innovation actors in terms of the skills of organizing data appropriately as well as the ability of identifying and select relevant data. Difficulties occur as to how to manage the amount of information available, and how to select information that is only relevant to the technologies and products that companies are seeking to develop. Increasingly, this means the connection of different databank and linking different organizations in order to access to different expertise. Thus while managers involved in the innovation process have to manage across organizational boundaries and extend their responsibilities to deal with the external environment.

#### **1.2.4.2 Complex Knowledge Infrastructure**

Another key challenge is related to the complex knowledge infrastructure generated from the institutional and organizational relations within innovation systems.

Creation of knowledge based competitive advantage results not only from the resources but also from the creative combination of resources and resourcefulness where resourcefulness consists in the ability and skills to configure these resources (Porter M. E., 1990). Establishing and enhancing the knowledge infrastructure is seen essential in terms of providing relevant resources for firms to innovate, which becomes the key agenda for the knowledge-based innovation.

The changing nature of knowledge in the new economy induces changes in the configurations of knowledge infrastructure. Previous innovation studies have focused either on pure scientific invention in the university laboratory or heavily on firms

because the firm is the main repository of productive knowledge in capitalist economies (Cooke and Morgan, 1998). However such views might not be applicable in the new production of knowledge where knowledge infrastructure not only involves traditional public institutions, such as national research centres and universities, but also new forms of organizations, such as business support agencies and professional consultancy services etc.

The new knowledge infrastructure has created the challenges in terms of managing new patterns of relations and developing new ways of communications emerged from the complex institutional and organizational interactions and networks.

#### **1.2.4.3 Problems of Coordination**

The ability of coordinating the process of interactions networking is seen as crucial in knowledge-based innovation. (Rice R.E. and Grant A.E. and Schmitz J. and Torobin J., 1990, Liebeskind J.P. and Oliver A.L. and Zucker L. and Brewer M., 1996, Castilla E. and Hwang H. and Granovetter E. and Granovetter M., 2000, Huggins, 1998, Saxenian A., 2000, Biemans W., 1992). However observations and empirical research have shown that coordination appears to be problematic in the dynamic networking context. It is identified that the problem of coordination is mainly associated with two key factors: uncertainties from the knowledge economy and diverse interests and roles of innovation actors.

Uncertainty and increasing complexity with respect to the technology and market are the key nature of modern innovation process (Dosi, 1998; (Mytelka and Smith, 2002, Rosenberg, 1982)). Individual firm capacities are certainly important in researching and developing new technology to gain competitive advantages in the turbulent business environment. Many work has addressed the importance of collaboration through networks in reducing risks and uncertainties. It is argued that embedded relationships developed through networks can take advantage of specialized assets, skilled labour, and spillover of knowledge. These resources sharing and information exchange activities also have resulted in external scales of economies and improved the competitive advantages of the firm substantially (Soh and Roberts, 2003, Cohen and Fields, 1999). The sources of uncertainty also come from the unpredictable outcome of innovation. The new production of knowledge by its nature shows that the



success of innovation is determined by many factors rather than a single act.

It is argued that diverse interest and different roles of innovation actors in the innovation networks have also caused difficulties of coordinating the process of innovation (Bijker et al., 1987). It is no doubt that effective networking requires actors establishing shared understanding on innovation problems and developing solutions through collective actors. However, misunderstanding may occur when individual actors are motivated by self-interests associated with different institutional norms. The diverse interests of innovation actors are manifest at not only organizational and institutional level, but also at operational and individual level when innovation tasks are organized across organizational boundaries.

### **1.2.5 Summary**

The section provided a comprehensive understanding the notion of knowledge-based innovation, which is the focus of current research project. It started by reviewing the traditional approach of innovation and the theoretical assumptions underlying the models. It is noted that innovation has been shifted from the linear model to a dynamic process where multiple links, networks and collective actions are playing significant roles in knowledge creation. The system approach and social network of innovation were introduced and the influences of macro institutional infrastructures and micro social and organizational process were elaborated and explained in order to understand the key nature of knowledge-based innovation.

Critically reviewing current literature shows that the key driver for developing knowledge-based innovation comes from the desire of creating sustainable knowledge-based competitive advantages in the fast changing global market. It is noted that in the changing economic context, the ways of knowledge generation and diffusion has shifted from traditional science based inventions towards new production of knowledge which emphasizes knowledge sharing and collaboration across various disciplines as well as the context of knowledge application. However the new business practice and changing processes of innovation have raised significant issues for developing knowledge-based innovation in terms of accessing and evaluating dynamic information, managing complex interactions and

relationships within innovation networks at multi levels and developing appropriate coordination mechanisms.

Despite various innovation challenges imposed by the process of knowledge creation, the significance of knowledge-based innovation in generating economic growth has been widely recognized and reinforced by the success of a number of high performance regions and significant knowledge intensive activities conducted within those regions (Saxenian A., 2000, Castilla E. and Hwang H. and Granovetter E. and Granovetter M., 2000, Gordon and Kimball, 1998), which has inspired growing interests in studying knowledge-based innovation in a regional context.

### **1.3 Regional Focus of Knowledge-based Innovation**

The issues of territorial configuration in enhancing learning process and knowledge creation have been argued by many scholars and policymakers. The regional focus of knowledge-based innovation to the great extent is associated with the increasing suspect that specific spatial arrangement of economic activities into geographical agglomerations might also in itself somehow influence the creation of knowledge, and consequentially, economic growth (OECD, 1999). It is argued that despite several excellent studies of dynamics of individual regions, the role of regions in the new age of knowledge-based global capitalism remains rather poorly understood (Cooke and Morgan, 1998). This section attempts to explore the importance of regional basis for knowledge creation and diffusion and the key issues related to successful development of regional innovation.

#### **1.3.1 Importance of Regional Innovation**

The role of region in transforming the old economic activities into the new knowledge economy through mobilizing and improving its assets base has been widely recognized (Storper, 1992; De Vet, 1993; Florida, 2000; Cook, 1998, 2001, 2004; Acs 2000; (Chaiton A; Dibbits T; Paquet G; Roy J; Wilson C;, 2002, Fornahl D. and Brenner T., 2003). The networks created as a result of globalization and information technology has enabled regions to be successfully integrated into global flows of information and knowledge, replacing space of places by space of flows (Castell, 1989). Region has seen as an important context of innovation for a number of reasons.

First, the development of multi-level governance particularly in EU means that countries are less able to play the dominant role in national industry, regulation and competition policy in the way as they did before (Begg and Mayes, 1993). Especially, the increasing fund on regional economic development by EU indicates that regions are seen as play a significant role in the knowledge economy through the implementation of science and innovation policy.

Second, the increasing competition from globalization force companies rethinking their R&D strategies for innovation and seeking to integrate local skills, knowledge and regional advantages such as regionalized supply chains, with existing innovation strategies. (Saxenian,2000, Smith, 2000; Acs, 2000; Florida, 2000). Evidence shows that industrial clusters and trade flows in general, particularly technological trade flows occurring at the most localized (Jaffe A.B. and Trajtenberg M. and Henderson R., 1993, Dalum, 1995). It is identified that spatial proximity and networks are crucial in determining the outcome of firms' activities (Krugman, 1995). The networks between firms go beyond the mere exchange of goods and services and include social capitals where relevant information is shared (Todtling and Kaufmann, 1999) This brings about the exploitation of the dynamics relative advantages of a given territory (Heraud, 1994) and regions have become more important bases for specialized externalized industrial activity.

Thirdly, there has been growing interests in studying the relationships between knowledge incentive activities and geographical arrangements. The argument is in particular focused on types of knowledge within innovation in relation to the importance of geography (Maskell and Malmber, 1999; (Asheim and Gertler, 2005). Innovation has been seen to be increasingly based on interactions between firms (customers, suppliers and customers), knowledge providers (research institutions), public agencies (technology transfer centers, regional development agencies) and other intermediary organizations (chambers of commerce, venture capitalist, business information centres). As these interactions and links are often embedded in the regional context, innovation thus is based on the development of trust relations within the interactive networks and access to relevant information. Since trust is not widely accessible and is embedded in the social interactions (Cooke and Morgan, 1997; Molina-Morales et.al, 2002), region can provide a platform in which actors may

establish through proximity relations through face-to-face contact (Saxenian, 1994; Chaiton et.al 2002).

Finally, although the system approach of innovation was first introduced at national level (Lundvall B. -A., 1992) which reflects the national impact on innovation dynamics, it is argued that the existence of regional socioeconomic and institutional peculiarities influencing the endogenous mechanisms of knowledge incubation, production and diffusion is often better understood at a regional level (Santos, 2000). Important elements of the process of innovation tend to become regional rather than national. The trends are most important in the science-based and high-technology industries (Krugman, 1995). Although national innovation system still play an important role in supporting and directing processes of innovation and learning (Acs, 2000), the globalization and regional system of innovation might be interpreted as processes which weaken the coherence and importance of national system (Lundvall, 1988, Lundvall B. -A., 1992).

The significance of region in shaping innovation process has made regional innovation system one of the central themes of innovation studies.

### **1.3.2 Regional Innovation System (RIS)**

Despite the tendency of research into geographical concentrated innovation activities, the concept of regional innovation is a relatively new one since it was first introduced in the early 1990s (Asheim and Isaksen, 1997, Cooke, 1992, Cooke, 2001, Cooke, 1998a) following the concept used by Freeman (1987) when he studied the Japanese economy and examined the national innovation system. The study of RIS derives from various attempts in explaining the success of emerging economies based on industrial districts and regional clusters in the 1990s (Beccatini, 1990, Molina-Morales et al., 2002, Boschma, 1999, Porter, 2000, Enright, 1995). The fundamental argument underpinning these studies is that the development of interactive relations between firms and regional knowledge infrastructure is the key for generating innovation capacities. Therefore regional innovation system can be thought of institutional infrastructure supporting innovation within the production structure of the region (Asheim and Cooke, 1999).

Reviewing on the existing literature of RIS shows that the concepts have been studied by various communities of researchers who have divergent views on what RIS should be and how it can be developed to upgrade the knowledge base of the region, improve the competitiveness of firms and enhance regional innovation capacities. Some focused on the broad review of institutional links at the strategic and policy level within the regions (Benz and Furst, 2002, Fromhold-Eisebith and Eisebith, 2005, Gebhardt et al., 2004), whereas others consider the RIS should include all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring (Lundvall, 1992). The central concerns emerging from these studies are (1) why innovation capacities between regions are different? (2) how RIS support the innovation activities within the region and developing innovation capacities? The attempts to address these concerns lead to different focuses on the relationships between the role of region as a geographical location, innovation actors and the network feature of the RIS.

#### **1.3.2.1 The Spatial Configuration**

The spatial configuration focus on the role of region as a geographical territory and social bounded structures in providing and shaping the innovation activities of firms operating within the region.

Many empirical studies have been conducted in the successful knowledge based regions such as Silicon Valley, the 'Third Italy' and other high performance regions (Simmie, 1998; Saxenian, 1991, 2000) identified that the key factors in determining the success of the innovation and competitiveness of firms located within the region are, as referred by Asheim (2005), the *territorially embedded regional innovation system* where firms base their innovation activities mainly on localized learning processes stimulated by geographical, social and cultural proximity. However this approach is criticized by its over-emphasize on the social embedded relations within the core regions and high-tech industries and lack considerations on the role of formal institutional infrastructure within the regions. In addition, it is hard to identify whether the proximate relations are resulted from active interactions and collaborations between firms in high-tech industries which are located within the core regions, or merely a distinguishing factor related to the historical and cultural conditions embedded within the region. Simmie (1998) points out that that these characters are

not common in all high-tech clusters or other innovative regions and there is little explanation on how and why innovation arises in the first place. Similar views are also expressed by Storper (1992) who argue that the process of innovation rests on an extraordinary complex variety of institutions, social habits, ideologies and expectations, whereas the social structures are seen to be bound to specific regions. The sporadic nature of such studies may result in the inconsistency of using the conceptual tools across different studies and applying in a different context (Wiig and Wood, 1997).

Whilst the social and embedded learning process through informal interactions within the RIS has been well addressed in the literature of innovation, it has been argued that the formal institutional relationship within the region should not be ignored. Asheim (2005) points out that in certain regions where formal systems of learning play an important role in determining the outcome of innovation. Such RIS is characterized by a more planned approach through policy intervention and strong institutional infrastructures such as R&D institutes, vocational training organizations and other local organizations involved in firms' innovation processes.

The geographical aspect of RIS discussed above reflect the point made by Lundvall (1992) that an innovation system is a set of relationships (formal or informal) between entities or nodal points involved in innovation. It is therefore important to understand the role of region as a geographical location in providing an environment that is conducive to interactive learning and facilitating such process through formal institutional arrangement.

Whilst economists seek to explain the diverse innovation activities and economic performance through examining different characteristics of regions, regional geographers turn to analyze innovation activities in different industries and identify how RIS is created to support the knowledge bases embedded in the region.

### **1.3.2.2 The Innovation Actors, Activities and Knowledge Base**

Although both theoretical concepts and empirical evidence support the view that the more knowledge-intensive the economic activity, the more geographically clustered it tend to be. The question of how RIS can be developed to support and enhance knowledge creation activities and develop innovation capacities remains central

debates of innovation studies. In stead of concentrating on the analysis of the systems, researchers seek to tackle this question argue that RIS vary due to the differences of industrial knowledge base, individual firm strategies and the absorptive capabilities of innovation firms within the region (Asheim and Coenen, 2005, Cockburn I. and Henderson R., 1998, Cohen W.M. and Levinthal D.A., 1990, Lim, 2000).

Based on the investigation of various industrial sectors and the knowledge sources and the analysis of the process of knowledge creation, Asheim and Gertler (2005) distinguish between two different types of industrial knowledge bases: 'analytical' and 'synthetic'. It has been widely acknowledged that the process of knowledge creation needs a dynamic interplay between, and transformation of, tacit and codified forms of knowledge as well as a strong interaction of people within organizations and between them (Nonaka and Takeuchi, 1995). It is argued that the analytical and synthetic knowledge bases will entail different mixes of tacit and codified knowledge as well as different codification possibilities and limits. The synthetic knowledge base prevails in industrial settings where innovation takes place mainly through the application or novel combination of existing knowledge and the innovation process for industries with a synthetic knowledge base tends to be oriented towards the efficiency and reliability of new solutions, or the practical utility and user-friendliness of products from the perspective of customers. In contrast, the analytical knowledge dominates economic activities where scientific knowledge is highly important and where knowledge creation is often based on formal models, codified science and rational processes. knowledge inputs are often based on reviews of existing studies, and knowledge generation is based on the application of widely shared and understood scientific principles and methods, knowledge process are more formally organized (e.g. R&D departments) (Asheim and Gertler, 2005).

The distinctions between different industrial knowledge bases have certainly provided useful implications for designing an effective regional supporting structure according to the different innovation needs of industries. However, innovation capacities of firms are not only influenced by the environment in which they interact and perform, but also associated with other factors such as firms' own strategies, capacities of implementation and abilities of learning.

Todtling (1992) indicates that regional firms may adopt different innovation strategies in accordance with the sector specialization as well as their functional and organizational characteristics. In the comparative study of regions within Europe, Todtling (1999) further identifies that the strategies of firms engaging in the innovation process is also influenced by the level of trust relations with collaboration partners and the level of competences within firms. In addition, the ability of firms to interact and access to relevant information, assimilate it and apply it to commercial ends may be different (Cohen W.M. and Levinthal D.A., 1990) which in turn affect firms' demand for innovation and attitude for cooperation (Saxenian, 1994; Cooke & Morgan, 1998). The absorptive capacity of firms to innovate does not only depends on the direct interactions with external environment, but also depends on the internal communication and abilities of information process within the firm (Cohen W.M. and Levinthal D.A., 1990). What's more, it is argued that innovation is more than technological changes, organizational changes, which often occur along with new product introduction and development (Edquist, 1997; Dosi, 1988), the ability of firms to adapt new organizational practice is different.

From this perspective, the focus on the innovation actors and their activities form an important part of studying RIS, which embodies diversity of institutional actors and relationships, complex networks of firms, business support organizations, universities, R&D labs and government agencies etc. It is through the complex interactive networks of innovation actors that the RIS can be constructed and developed.

### **1.3.2.3 The Networks Support within RIS**

If the distributed networks and the interdependency relations between innovation actors are seen as an important aspect of RIS, the key issue is how networks function during the process of innovation and how they are established and maintained for knowledge creation and innovation capacity building.

The studies of networks within RIS is largely underpinned by the proposition that (1) In the era of globalization and knowledge economy firms need to pay attention to 3Cs (concepts, competence and connections) during the innovation process (Kanter R.M., 1989); (2) innovation and learning occur in various kind networks where different actors become involved (firms, knowledge providers such as universities, government



agencies, technology transfer centres etc., other public / private support organizations) (3) networks through local institutional relations and information contacts within the region have significant impact on the performance of innovation (Acs, 1990, Acs et.al 1993; Acs, 1996; Jaffe et.al 1993). The current literature on the network approach of RIS spans various academic disciplines such as sociology, social psychology, organizational behaviour and business strategy, which make it difficult to reconcile the relations between networks and innovation.

The significance of network support lies in its benefit of helping innovation actors access to relevant information, which has been considered as an important local condition for innovation (Smith Lawton, 2000). It is argued that the benefits resulting from the network support within the region include the forms of resources and the knowledge that collaborative alliance provide to entrepreneurial firms (Powell and Grodal, 2005, Baum et al., 2000). It is argued that the success of a startup firm is highly dependent upon the networks in obtaining resources (Larson, 1992). This point is further developed by Baum, Calbrese and Silverman (2000) who investigated 142 biotechnology firms founded in Canada and claimed that network efficiency defined as the diversity of information and capabilities per alliance, showed a large positive effect on the number of biotech patents.

However, how to access to relevant information will depend on the nature of the information and the relationships between institutional relations. For instance, some information is available for public, whereas others such as special licensing arrangements or patent etc., need to be exploited within particular institutions, such as university or national laboratories. Information as 'free good' (tacit knowledge) is available through informal networks and interactions (Owen-Smith and Powell, 2004, Brown and Duguid, 2002). Although to establish and develop a sound knowledge networks is important to provide information for innovation purpose, it is noted that the nature of the demand for information owing to region is also important (Smith Lawton, 2000). Particularly in the technological oriented innovation culture, whether the region can provide information for different types of firms and sectors associate with their innovation activities remain a critical issue. Creating robust system of institutional support through networks has been seen as important (Best M., 1990) in

terms of stimulating and implementing innovations through government coordination of a wide range of actors from public and private sectors including business support organization, training agencies and financial institutions offering capital support for firms etc. which play an important role in terms of offering professional advice on information, labor force in the market and capital support for firms to conduct innovation activities in the region (Todtling and Kaufmann, 1999). In addition, the role of government is increasingly seen as an essential part of regional innovation system by providing 'rules of the games', organizing principles during the process of innovation (Hodgson, 1988, Edquist and Johnson, 1997).

Despite of the benefit of network support within the innovation system, it is argued that the network itself could become the barriers of developing new sources of information. There is an inherent danger of 'lock-in' owing to the homogenization of 'world views'(Grabher, 1993). The established institutional norms may become an obstacle to adjust or change for knowledge sharing and innovation activities. It is clear that generating regional innovation capacities has been linking with different variations deriving from the specific regional context, the organizational practice of innovation as well as local institutional network support and the effect of these variations has on the process of knowledge creation. Because of this complexity, creating an effective knowledge-based innovation system requires a deep understanding on how these variations from different dimensions interact for knowledge generation and diffusion. Managing the diversified issues and dynamic interactions needs to develop the capacities of learning at regional level.

### **1.3.3 Learning Region**

Knowledge economy requires a new kind of region. The central point of learning is that regions are becoming the focal points for knowledge creation and learning in the new age of capitalism ((Morgan K., 1997, Boekema F. and Morgan K. and Bakkers S. and Rutten R., 2000, Simmie J., 1997, Florida R., 1995). Learning region, as Florida (2000) argues, function as collectors and repositories of knowledge and ideas, provide an underlying environment or infrastructure which facilitates the flow of knowledge, ideas and learning.

In the model of learning region, sustainable advantage based in knowledge creation and the governance systems is featured by network organization and mutually dependent relationships. Institutions should not be treated as isolated actors, rather they should be considered as a dynamic process of institutionalization in which the social capital such as informal relationships and trusts play a key role (Florida, 1995; Morgan, 1997). Pratt (1997) points out that learning region is a particular structured combination of institutions strategically focused on technological support, learning and economic development that may be able to embed branch plants in the regional economy, hence cause firms to upgrade in situ rather than to relocate away from the region. Therefore, to develop the knowledge economy, regions must adopt the same principle of organization, ie. the knowledge creation and continuous learning. Linking to the learning region to the importance of the context of regional innovation, Florida (2000) stresses the importance of role of learning region in promoting an environment that is required for knowledge-intensive organization to flourish. A learning region should also facilitate information sharing within the region and integration to the global economy.

Another key feature of learning region, as Lundavall and Johnson (1994) indicate, is cooperative networks. Because firms are increasingly chosen in order to enhance their learning capabilities through networking with other firms, horizontal communications patters and frequent movements of people between posts and departments. Schon (1960) identified a number of factors in terms of the 'network roles' for enhancing the learning capabilities.

- Systems negotiation – the middleman who sensitizes others to system-guidance issues;
- Underground manager – maintains and operates information personal networks to keep system coherence;
- Manoeuvrer – mobilizes internal resources to shift projects in new directions ;
- Broker –mobilizes external resources to smooth transactions requiring trust;
- Network manager – provides resources needed for such networks to function in the 'official' system;
- Facilitator – provides interface relations with distinctive 'regional enterprises'.

Schon's view takes the analysis of learning outside traditional focus of organizational learning which is focused on individuals and organizations and into the broad innovation context in which actors interact through networks. Therefore, the role played by individual actors within the networks is crucial in developing relevant learning experiences.

Cooke and Morgan (1998) further argue that one of the outcomes of effective learning is changing in a person's or organization's capability or understanding. As Eraut (1996) points out, learning is more than simply the acquisition of information. Learning takes place in the process of interaction between what we know and bring to a situation and what perceive to be new about the situation (Piaget, 1971). Learning as an important process of knowledge creation has been manifested in high performance regions through various empirical studies. Whilst new patterns of innovation has emerged which has brought about new ways of organization and communication processes, this will require tremendous energies and effort of innovation actors to set in motion the necessary resources for developing effective learning.

### **1.3.4 Summary**

The new age of economy and the shift towards localized knowledge intensive productions and processes have brought region as the focal point of generating knowledge-based innovation. This section sketched the importance of geographical configuration of economic activities conducted by key innovation actors – firms, universities and government agencies etc. It is argued that region plays a significant role in shaping the innovation capacities of firms and industries through both formal institutional network support and informal relations embedded in the social and cultural context of the region. Three key aspects of RIS have been described and discussed in order to identify the key factors related to the uneven distribution of innovation activities across different regions. It is argued that RIS may vary due to different spatial configuration, the strategies of innovation actors and forms and processes of network support within the region. In addition, the support provided by RIS also depends on the different industrial knowledge bases within the region. In order to manage the dynamics of knowledge-based innovation in the regional context,

the notion of learning region was introduced and explained in terms of how learning provides critical inputs required for successful knowledge creation.

Despite continuing effort in researching the development of knowledge-based innovation, there has been lack of a conceptual framework that can be used to incorporate different aspects of innovation practice and organizational changes and analyze the critical issues involved in the process of knowledge creation at regional level. In particular, the implications do these dynamic features identified in successful regions have for less-developed regions when adopting knowledge-based innovation strategy remains unclear. One way of understanding these dynamics is through the Triple Helix networks of university-government-industry in the process of innovation.

## **1.4 Triple Helix of Knowledge-based Innovation**

The recognition of knowledge-based innovation through collective actions and new production of knowledge has broken the classic approach of innovation at individual firm or organizational level. Knowledge-based innovation in so far has been associated with various models and frameworks where new patterns of innovation for knowledge generation and diffusion are the central point of discussion. The concept of Triple Helix (TH) has been invoked as an important expression of the emerging patterns of innovation through analyzing the relations of university-government-industry (Etzkowitz H. and Leydesdorff L., 2001, Leydesdorff L., 2001, Sutz J., 2001, Shinn, 2002; Inzelt, 2004; Sadd, 2005; Marques, 2006; Baber, 2001 ).

In this section, the Triple Helix relations of university-government-industry as an important conceptual framework will be explored and the key arguments will be critically examined in developing knowledge-based innovation.

### **1.5.1 The Concept of Triple Helix**

Recent literature on studying knowledge-based innovation has been associated with the concept of Triple Helix of university, government and industry relations (Etzkowitz H. and Leydesdorff L., 2001, Leydesdorff L., 2001, Sutz J., 2001, Shinn, 2002; Inzelt, 2004; Sadd, 2005; Marques, 2006; Baber, 2001). The core elements of TH are surrounding the new patterns of innovation in relation to economic growth and the focus of the analysis is based on the interactive relations of university-

government-industry.

The Triple Helix model, which was founded by Etzkowitz and Leydesdorff, compensates the limits of traditional linear approach of innovation where theoretical and practical issues are explored within a separate institutional sphere (namely, university and industry) with the emphasis on the impact of the transformational changes across institutional boundaries between university, government and industry, which are viewed as the key player of knowledge-based innovation. The central argument is that university, government and industry that were differentiated with each other as a condition for the constitution of modernity are now intersecting with each other to create unique institutional configuration (Baber, 2001) for developing knowledge-based innovation.

It is argued that in the knowledge-based innovation, changes occur within and between the institutional spheres of university, government and industry (Etzkowitz H. and Leydesdorff L., 1997). Universities are taking the role of business and become more entrepreneurial oriented and act as consultants ((Etzkowitz, 2004). Industries are involved in more research in new technology development through the establishment of research centres. Government are pushing interactions between university and industry through designing and implementing innovation programmes and acts as business organizations ((Etzkowitz H. and Leydesdorff L., 2001)). As a result, networks are created among the three institutional spheres in common projects aiming at developing economic growth and knowledge-based innovation. New initiatives arise from these networks become source of innovation. New organizational arrangements and new channels of interaction become as important as the creation of physical devices in speeding the pace of innovation.

As Etzkowitz (2003) suggests that instead of focusing only on the potential for product development from individual technologies, there is broader concern with creating an infrastructure for innovation in innovation through the construction of hybrid regime that involved academic, industrial and governmental partners. Four stages have been identified in the emergence of a Triple Helix innovation model (Etzkowitz, 2003). These stages include

- The internal transformation in each of the helices;
- Influence of one helix upon another;
- Creation of a new overlay of trilateral networks
- Organizations from the interaction among the three helices

A recursive effect of Triple Helix networks both on the spirals from which they emerged and on the larger society. All the four stages indicate that process of each sphere in adapting its new role while performing existing roles, also creating new set of relationships whilst maintaining existing networks. The changing relationships between university, government and industry are shown in figure 1.1

### Tri-lateral networks and Hybrid Organizations

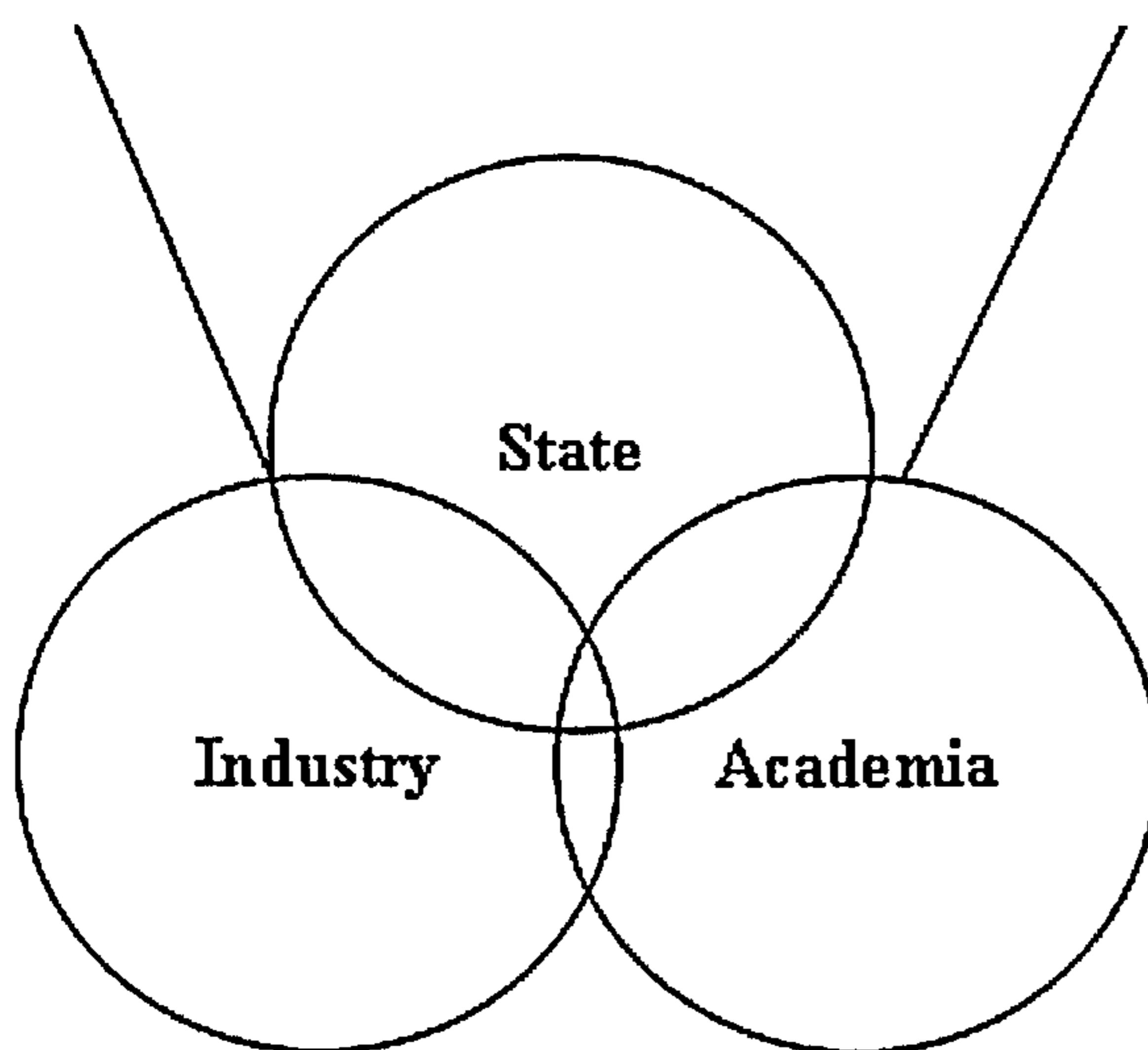


Figure 1.1 Triple Helix Model of University-Government-Industry relations. (Etzkowitz, 2003)

The Triple Helix relation of university-government-industry as a useful analytical model has captured the new dynamics of knowledge-based innovation in terms of both content and process. There are a number of positive narratives provided by the Triple Helix approach of knowledge-based innovation.

First of all, the TH states that new roles of innovation actors which are emerged from the transformational changes between and within the institutional spheres during the process of interactions. University, government and industries are taking each other's role and boundaries between institutional spheres become blurred in the process of

interaction. Secondly, the TH concept implies a strong interest among the three institutional spheres for knowledge generation and economic growth. Therefore the common interest for collective learning link individual actors together and create interactive innovation networks. Thirdly, cooperation between university, government and industry is perceived as essential for the success of knowledge-based innovation. Innovation is generated and evolved from the continuous interactions and networking between the three spheres. As Gebhardt et.al (2004) point out the interaction among university, industry and government is the key to improving the conditions for innovation in a knowledge-based society. Networks among the institutional spheres increasingly provide the source of innovation rather than any single driver. New knowledge is produced as well as circulated within the three institutional spheres. Finally, based on the observations and empirical evidence collected from the successful regions, the concept of TH denotes that economic growth is a result of effective interactions and cooperation networks between university-government-industry.

Although the strategic value of TH concept has been widely acknowledged as a model of knowledge-based innovation which highlights the core elements and subjects at the heart of the economic growth, the conceptual framework presented by TH needs to be critically examined, in particular to what extent the theoretical arguments of TH model can be applied outside the high performance region from which it is derived needs to be explored. Exploring the implications of TH concept requires a further understanding on the transformational relations of university-government-industry.

### **1.5.2 Transformational Relations within Triple Helix**

The first critical issue highlighted by TH is the reorganization of the transformational changes and knowledge flow within each institutional dimension of university, government and industry, and the impact of mutual interactions in reconstructing their new roles during the process of innovation. Thus it is important to understand the changing relationships and roles played by each institutional actor in the knowledge-based innovation

The changing university-industry relations can be seen driven by the following developments:



- Increasing demand for new knowledge, skills in response to the new economy (Nonaka and Takeuchi, 1995); Lundavall, 1997) and grasping competitive advantages (Porter M. E., 1990)
- The increasing importance of scientific knowledge as sources of innovation and economic advantage in science-based industries where the lags between scientific discoveries and industrial applications appear to have shortened, and the boundaries between science and technology are becoming blurred (Gambardella 1995; Powell and Owen-Smith 1998; Gray, 1999).
- The development of new production of knowledge with new way of organizing process of innovation through collaborations between university, academics and industry (Gibbons et.al, 1994; Cohen and Levinthal, 1990, Cockburn and Henderson, 1998; Howells, 1996)
- The changing structure of government, and a great diversity of bodies have a stake in the governance of territory and the delivery of public services (Tomaney, 2000)
- The changing nature of industrial development which is reflected by the decline of traditional sector and emerging new sectors (Charles, 2003).

The changing relations between university-industry also denotes a significant shift in the relationship away from the older linear model of one-way knowledge transfer which firm is perceived as the repository of the knowledge, to an interactive model of two-way knowledge exchange between the two systems (Cooke and Morgan, 1998) because both sides contribute to ongoing processes of competence creation, knowledge acquisition and knowledge transfer (Newlands D., 2002). One of the key evidences of the changing university-industry relation is the emerging role of university as knowledge institution in creating wealth and economy (Gunasekara, 2005, Asheim and Coenen, 2005, Etzkowitz, 2004, Gunasekara, 2004, Newlands D., 2002, Sutz J., 2001, Goddard J., 1994, Goddard J., 1999). For instance, In the UK, the government policy statement has particularly focused on the role of higher education in underpinning economic vibrancy within a context of support for innovation. The DTI/DfEE White Paper on Enterprise, Skills and Innovation states that:

*'The role of our universities in the economy is crucial, They are powerful drivers of innovation and change in science and technology, the arts, humanities, design and*

*other creative disciplines. They produce people with knowledge and skills; They generate new knowledge and import it from diverse sources; and they apply knowledge in a range of environment. They are also the seeded for new industries, products, and services and are at the hub of business networks and industrial clusters of the knowledge economy.* (DTI/DfEE, 2001)

The role of university in regional innovation has also been paid increasing attention in terms of providing human capitals and shaping the social and cultural dimensions of economic development. Successful innovation in those perceived as knowledge-intensive sectors increasingly require a greater variety knowledge across different scientific disciplines and functional areas, and the connectedness within and among them (Liebeskind et.al.,1996; Shan et.al., 1994; Owen-Smith and Powell, 2003). The role of university in developing successful technology-based clusters is evident in a number of high technology regions through the establishment of spin-off firms (Lawton Smith, 2003).

The transformational relation between university and industry is also manifested in the interdependent relations established between academia and firms based on mutual interests. For instance, the motivation behind the university commercial activities, as argued by Thursby et.al (2000) are the increased willingness of professors to patent their inventions without a shift in the type of research itself or a much more fundamental change in the type of research to be more commercially oriented. Empirical research shows that not only do university researchers work in cooperation with industry, but frequently university research produces knowledge or processes that are spin-off from their institutions or have the right sold to private sector companies who then develop the technologies.

From industry perspective, it is argued that the innovation strategies within industry have also changed with the increasing demand for new knowledge. According to Cooper et.al (1995) and Newlands (2002), firms are keen to purchase output of academic research for two reasons: first universities contain publicly subsidized academic researchers, so private costs are absorbed at the public expense; second, university is better placed to take on the risk of intensely original research which would otherwise impose costs on business if they had to anticipate the burden of

failure. Evidence also shows that productivity of firms having partnerships with universities are higher than those who do not have the partnerships. Firms involved in research universities in particular earn substantial benefits in increased productivity, profitability and innovation (Coopers & Lybrand (USA). 1995). The changing relationships between university-government-industry has also led to a transformation of the organizational arrangements within government designed to assist innovation, collaboration and consortia in and across industrial sectors and the construction of hybrid organizations to facilitate interactions, information exchange and collaborative innovations between (Etzkowitz H. and Kemelgor C, 1998; (Robertson, 1999; Gray, 1999).

Although the discussions are focused on different perspectives of innovation policy, it is clear that traditional role of government in innovation policy is seen shift from designing, planning and monitoring towards the facilitating and engaging with academic research and industrial production during the process of knowledge development. On one hand, government acts as the source of contractual relations that guarantee stable interactions and exchange (Leydesdorff, 2004); On the other hand, in order to manage the programme effectively, government managers need to collaborate with programme participants, exchange resources and negotiate values ((Rhodes R.A.W., 1997 (a)). The active role of government in developing knowledge-based innovation also helps policy makers to understand and learn from the dynamics and insights of the broad landscape of innovation, thereby to develop new policies that address the issues raised during the process of knowledge-based innovation (Nauwelaers, 2000, Mytelka and Smith, 2002, Benz and Furst, 2002).

Despite the described changes of university-government-industry relations and a number of many studies on the external orientation of university has been described by a number studies ((Gulbrandsen and Smeby, 2002, Langberg, 2002, Benneworth, 2001) relating to the commercialization activities, close examining existing literature shows little evidence on what are the differences of the roles playing by university, government and industry in developing knowledge-based innovation comparing with their traditional roles. Jensen (2002) reported that even researchers want to break through the traditional boundaries and step into the new economy, the new roles are challenged during the interactions with TH partners. The key question is to what

extent actors from different institutional sphere shift from their traditional role towards the new roles described by TH model of knowledge-based innovation.

### **1.5.3 Critical Issues of Triple Helix**

The emphasis of the transformational relations in developing knowledge-based innovation implies that economic growth is a result of the collaboration and interactions between university-government-industry. In another word, TH is a key indicator of knowledge economy. Although the TH relation of university-government-industry is supported by empirical evidence from in a number of successful high performance regions, the concept and propositions of TH is challenged from a number of perspectives:

First of all, the linking between economic growth and university-government-industry relation has raised the question of whether knowledge-based innovation can be achieved through the creation of collaborative relations of university-government-industry in the regions. In another word: is TH model a driving force for developing knowledge-based innovation, or simply a feature of the high performance region which have been identified in the successful knowledge economy? Whilst cooperation is observed as the key feature of TH model of knowledge-based innovation, the core elements of innovation system, such as regional government, trade associations, chambers of commerce, labour unions and the like are very often part of the problem of generating new practice based on cooperation (Morgan and Nauwelaers, 2003)

Secondly, one of the key features emphasized in the transformational relations of TH is cooperation between university-government-industry for the common interests of developing knowledge-based innovation. The underlying assumptions are that the cooperative relations already exist in the first place and knowledge flows automatically between the institutional spheres. The willingness for cooperation between institutional partners has been underestimated. Empirical evidence clearly suggests that academics and firms are motivated by different objectives when collaborating for innovation projects. The key question is how cooperation relations are established and how innovation actors are motivated to interact for knowledge creation by self interest.

It should also be noted that despite various government policy in addressing the important role of university in contributing to the knowledge economy. In a very real sense, higher education is evolving from a loosely federated system of colleges and universities serving traditional students from local communities to a *knowledge industry* (Duderstadt, 1997). academic debates on reshaping university as a key part of the knowledge production system in regional economies (Charles, 2003; Audretsch, 2005; Gunasekara, 2005), the strategic intention of encouraging proximity relations between university and local industry through knowledge spillovers is to some extent hindered by the university's orientation of building up global focus through its internationalization strategies, which is now one of the high priority for universities.

In addition, although social and institutional theories are viewed as important concept underpinning the TH concept and networks among the institutional spheres increasingly are addressed as the key source of innovation from which new knowledge is produced. As established previously, that traditional innovation is built upon physical infrastructure whereas new innovation practice is based on social capital – that is, a relational infrastructure for collective actions based upon trust, reciprocity and disposition to collaborate for mutually beneficial ends (Storper, 1995, 1997). However, what has been unclear within the TH concept is to what extent the institutional proximity and cooperation relations have an effect on the operational practice that leads to successful knowledge generation and diffusion.

Further more, the institutional interactions also lead to new communication processes between university, government and industry, which traditionally has its own communication structure and process which is not easy for outsiders to interpret (Etzkowitz H. and Leydesdorff L., 2001). Challenges occur when innovation actors from different institutional context work together to develop new knowledge. Innovation actors not only have to understand the norms, culture and languages from different context, but also have to interpret institutional languages in a meaningful way. In addition, the content of communication may have an effect on the channels of communication between institutions due to different nature of technology (Colyvas et.al 2000). In particular managing cultural differences between organizations remains significant challenges for innovation actors (Etzkowitz and De Mello, 2003, Saad,

2004) .

Finally, the pre-conditions for implementing TH has been raised as an important issue when analyzing the practice of knowledge-based innovation, particularly in less favoured regions where there is lack of relevant resources in terms of institutional infrastructure (Jensen and Trgrdh, 2004) and cultural conditions (Saad, 2004), how interactive networks can be established and supported in the local context remains critical for the success of knowledge-based innovation.

The critical issues sketched above have pointed to the needs of further examining the dynamics of knowledge-based innovation in a different regional context. As Shinn (2002) indicates, the issues surrounding how university-government-industry relations have changed, are changing and are likely to have change in shaping new knowledge production will require more in-depth case studies and analysis, in particular attention needs to be paid on how transferable is the high performance model associated with successful regional knowledge economy to a less favoured region and what implications does this have for innovation actors, the process of interactions and knowledge generation at a regional level.

#### **1.5.4 Implementing Triple Helix in a Regional Context**

Despite many research on knowledge-based innovation models, it is argued that there are still significant gaps between theories and practice, particularly in the area of less favoured regions (Morgan, and Nauwelters, 2003) where there has been problems of translating policy intentions of knowledge-based innovation policy into operational practice through fostering collaborative networks between innovation actors (CURDS, 2004; Benz and Furst, 2002;(Jensen and Trgrdh, 2004). Although the adoption of policy does not guarantee success (Stevens et.al, 1980) and it is too early make a judgment on impact of the these innovation policies in terms of generating innovation capacities, the successful implementation of the innovation programme needs to consider a number of perspectives:

As Morgan and Nauwelters (2003) point out, lack of capacity for cooperation between core elements of innovation system is the key issue within less-developed regions. Such structural weakness, argued, it can be improved through the creation of

agreement-reaching and cooperation-enlisting mechanisms to promote the growth of innovative linkages and more dynamic networks. However, cooperation is easier said than done. The implementation of innovation has to take into account of the dynamic roles and interests of innovation actors involved in the 'overlapping spheres' and 'network interfaces' as a result of the transformational relations of university-government-industry (Etzkowitz and Webster, 2000). Managing such complex networks requires collective endeavor and new ways of engagement with a variety of internal and external actors in the innovation process, spanning the private and public domains (Lam A., 2004). The key challenge for managers in TH networks is how to connect diverse interests and even conflicting roles in which new innovation practice and organizational routines are developed and new knowledge is generated.

The pre-condition for implementing knowledge-based innovation has been emphasized in TH concept. The cultural routines underlying the institutional inertia are as much a part of the regional problem as any conventional economic factor (Morgan and Nauwelaers, 2003). Thus implementation of the innovation policy needs to consider the historical and political process of the institutional relations within the region and identify barriers of developing collective actions and interactive networks. Interactive networking between institutions requires 'unfreezing' of the traditional attitudes towards its development paths and modes of actions in response to changes in order to generate paradigm changes for knowledge creation in the region (Benz and Furst, 2002).

Designing and implementing knowledge-based innovation is different from building up physical infrastructure within the region. New innovation practice through collective actors is increasingly based on social skills and expertise in building up relationships and managing expectations of diversified innovation actors at both strategic and operational level. In addition, during the process of knowledge-based innovation, a large part of the transfer of knowledge from academia to industry tends to be tacit and uncodified and requires the bench-level engagement between academia and firms which are characterized as two communities with divergent norms, incentives and modes of communications (Zucker et.al, 2002). Knowledge is always produced under an aspect of continuous negotiation and it will not be produced unless and until the interests of the various innovation actors are included (Gibbons et.al,

1994). Implementing knowledge-based innovation involves individuals work closely to establish trust and shared understanding to ensure the appropriation of new knowledge (Edward et.al 2004). Managing expectations and knowledge flows within and across institutional spheres remain a big challenge for the success of implementing innovation policy.

Policy doesn't implement itself, and policy needs to be activated in the sense of being put into action (Barrett and Fudge, 1981). If scholars are to achieve an understanding of the differentiation between 'policy promises' and 'policy products', the focus of research should be shifted from designing knowledge-based innovation models or innovation policies towards the analysis of the process of innovation policy implementation, the role of actors involved in creating new innovation practice and the processes in which innovation capacities is generated (Schofield J., 2001)

### **1.5.5 Summary**

This section provided a critical review on the concept of Triple Helix which has been regarded as one of the important model of developing knowledge-based innovation through the managing the relations of university-government-industry. The key features of TH which are derived from the high performance regions are highlighted and analyzed with focus on the transformational relations of university-government-industry. Critical review of TH concept identifies a number of theoretical gaps which need to be further examined and addressed through empirical research.

Finally, the need for exploring the implications of TH in a different regional context is discussed. Due to different interests and roles of innovation actors, historical conditions and dynamic institutional and organizational processes of innovation, the implementation of TH model of knowledge-based innovation is far more complicated than the prescribed contour of successful regions. The structural weakness for cooperation is addressed as the main deficiency in less favoured regions that hinders the ability of generating innovation. Therefore role of TH model in fostering cooperative relations between key innovation actors is essential for knowledge creation and diffusion.



## 1.6 Conclusion

This chapter sets up the strategic context for developing knowledge-based innovation from three perspectives: what is knowledge-based innovation, how knowledge-based innovation is generated and how to understanding process of generating knowledge-based innovation. The importance of knowledge in the changing global business environment has been highlighted with the emphasis on the changing patterns of innovation from traditional linear approach towards new way of innovation through collective actions. In particular, the new production of knowledge is viewed as an expression new innovation practice which addresses the importance of interactions and innovation linkages between traditional separate institutions. New patterns of knowledge creation and dissemination also create challenges for innovation managers in terms of coordinating information flow and effective innovation networks.

The tacit nature of knowledge points to the importance of spatial configuration in developing proximity relations between innovation actors and facilitating interactive innovation networks. It is for this reason that region is brought into the center of discussions for knowledge creation. The regional focus of knowledge-based innovation is also inspired by the leading example of those successful knowledge regions and the increasing pressure on less-developed regions in developing strategies for generating innovation capacities and economic growth. However the analysis of regional innovation system reveals that the process of generating innovation is underpinned by different sources of variations including the spatial configurations, diversified self-interests of innovation actors and necessary network support within the region. Differences in the theoretical focus have no doubt resulted in variations in understanding the dynamics of knowledge-based innovation. In addition, the impact and roles of actors from individual institutional domain tends to be overemphasized within the innovation networks. It is for this reason that the notion of TH is introduced as a way of understanding the dynamics of innovation process through innovation linkages between university-government-industry.

The nature and content of TH have been reviewed and examined with a particular focus on the prescribed transformational relations of university-government-industry in the knowledge economy and the positive narratives that are derived from the

successful innovative regions. Although the TH concept have certainly offered valuable strategic insights relating to creating knowledge-based innovation through fostering cooperative relations of university-government-industry, there are several critical issues which need to be addressed. The central argument surrounding the critiques of TH is: can knowledge creation be designed through the creation of cooperative relations of university-government-industry?

The most significant point is how the prescribed transformational relations of TH, manifested in the successful regions, can be fostered and managed in less-developed regions where the pre-conditions for collaboration appears to be problematic. Close examining the TH concept further points to a number of implementation issues when innovation programmes are designed to promote the growth of collaborative effort and interactive networks between university, government and industry in the regional context. Despite the strategic values of TH concept, how transferable and valid the propositions of TH are in a different regional context remains unclear. In particular, the appropriateness and effectiveness of TH concept has not been addressed within the existing literature.

It is this point that the next chapter will turn to in order to provide a conceptual framework that move beyond the strategic framework of TH and concentrating on the processes in which innovation capacities are generated through establishing and maintaining effective innovation networks among a wide array of institutional and organizational actors. The research focus thus is oriented towards three key questions during the implementation of TH model of knowledge-based innovation:

- How cooperative structure of TH is established and networks are formed to reflect the intention of partners for knowledge-based innovation?
- How innovation networks are organized and performed through collective actions and to what extent the interactive networks help to foster trust relations and facilitate information flow thereby generating innovation capacities?
- What are the key challenges facing managers involved in implementing TH model of knowledge-based innovation and how these challenges can be managed appropriately for the effectiveness of TH?

# **Chapter 2 Beyond Triple Helix: Implementing Knowledge-based Innovation**

## **2.1 Introduction**

Following the overview of the strategic context of Knowledge-based innovation and the examination of a number of key theoretical frameworks underpinning the development of KBI, this chapter turns the attention from the strategic context of KBI into the specific operational settings and identifies the process of implementation through Triple Helix networks to generate new knowledge and enhance innovation capacities.

It is noted that although networks have been addressed as important for innovation and knowledge creation, the existing literature on innovation networks tend to focus either on the structural linkages of networks that are exemplified by statistical modelling, or the relationships between organizations or individuals that are underpinned by social theories. The meaning of networks becomes ambiguous due to lack of differentiations on the types of networks and the level of interactions within networks when discussing innovation as conduct of networking. Chapter 2 aims to explore the networking issues by focusing on the following perspectives:

First, in order to understand the process implementing Triple Helix networks, the question of how strategic and institutional relations are formed need to be explored. Section 2.2 will introduce the notion of policy networks, which is adopted as a means of strategic intention to assist the establishment of initial institutional collaborative relations. The impact of the policy network on defining institutional roles, nature of relations and setting operational context of networking will be explored.

Second, forming strategic relations does not necessarily entail smooth operations of innovation activities unless it is activated through effective interactions and communications at operational level. Section 2.3 will investigate the key networking activities performed during the operational process of innovation and analyze the coordination mechanisms during the network operation.

Section 2.4 will deal with a number of practical concerns during implementation processes and how to manage the challenges emerged in the dynamic interactions of

networking. Finally, a theoretical model of implementing Triple Helix networks will be elaborated in Section 2.5 and the implications on empirical focus of the research will be highlighted.

## **2.2 Forming Triple Helix Networks**

Network as a means of organizing and achieving strategic objectives has been widely discussed in the literature of policy implementation, innovation studies and managing transformational changes involved public-private spheres (Burns and Stalk, 1961; Camagni, 1991; Howell, 1996; Harris et.al, 1999; Malecki, 2000; Pittaway, 2004; Harmaakorpi, 2005). New knowledge production and increasingly prevalent notion of knowledge-based innovation have further emphasized the significance of networking in generating innovation capacities through knowledge exchange between organizations and individuals (Powell et.al, 1996, Ahhenas et.al, 1995; Lam A., 2004; Miles and Snow, 1986; Swan and Scarbrough, 2005).

It has been noted that the central concern of Triple Helix framework is the institutional relations between university, government and industry in configuring the process of knowledge production, however, how the institutional relations are formed and to what extent the nature of the relationships and the role of each institutions have an effect on the process of knowledge production have been paid little attention. This section will examine the nature of the institutional networks within Triple Helix and explore how institutional relations are established and reinforced through innovation policy networks.

### **2.2.1 The Study of Network in Innovation**

Network as a metaphor has been widely studied in innovation literature and the meaning of networks has been interpreted in different ways. Close examination of the literature reveals three common themes:

- That network as as an object and pre-fixed setting, such as ties and assemblages (Granovetter 1973, 1982, Burt 1992 Hansen 1999, Marsden and Campbell 1984, Uzzi, 1997). The studies tend to focused on the analysis of the structural properties of networks and the depth and degree of intensity of connectedness in terms of the degrees of ‘closeness’ associated with the established networks. At

the dyadic level of networks, theories have arisen around both extremes of the tie-strength concept, with research finding advantages to both strong and weak ties (Levin et.al 2002).

- The focus of network as social relationship (Thompson G.F., 2003; Aldrich and Whetten, 1981; Nohria and Eccles, 1992).The interactive nature of networks offers another register to consider the kinds of connections that are set up and what sort of relationships are thereby invoked. The basis of such relationships may include roles, individual persons, organizations, affection, friendships, kinship, authority, economic exchange, information exchange etc. The main reasons identified for forming network relations include sharing information (Cross and Sproull, 2004; Burt 1992), interdependence (Crozier and Friedberg, 1980), solving complex problem (Hutchins 1991; Lave and Wenger, 1991) and knowledge transfer (Levin and Cross, 2004)
- Network is interpreted as a conduct or action (Alliez, 1996;; Harmaakorpi and Melkas, 2005; Camagni, 1991; Pratt, 1997) for achieving individual organizational strategy such as product development (McLoughlin, 2001; Harris et.al., 1999) during the process of organizational or product innovation. Network in this context is equivalent to ‘networking’ or collective actions for implementing strategies and policies (Friend et.al, 1974; Kickert and Klijn, 1997; Bogason, 1998)

Networking has been increasingly regarded as important tool for managing the dynamic changes and complex relations during the process of knowledge creation and innovation. Hay and Richards (2000) point out that all decisions to participate in networks are in some sense, strategic – as, indeed, is the very process of networking itself. If aspiring network managers, network initiates and hardened network participants, adopt a strategic approach to networking then, in seeking to understand the networking, it is the important to give due consideration on issues surrounding how network is initiated, formed, operated and adapted to achieve the strategic agenda. Thus studying the innovation networks within Triple Helix needs to take into considerations of both strategic and operational networking.

### 2.2.2 Triple Helix as Innovation Networks

One of the distinguishing features of Triple Helix model is the strategic orientation of reinforcing institutional interactions between university, government and industry in generating innovation capacities. In contrast to the traditional linear model of innovation either through technological push or marketing pull, the three institutional partners (university, government and industry) involved in Triple Helix innovation networks have to interact and negotiate with other two in order to gaining resources, knowledge and support which are core for generating innovation capacities. Triple Helix as a strategy for creating knowledge-based innovation is not only reflected in the government innovation programmes which call for collective actions between university and industries, but also embodied in firms' innovation strategy.

Although the strategic intention of Triple Helix is reflected through promoting institutional relations and interactions, relationships cannot be established unless networks are activated and performed both at various levels within in the organizations. In this respect, policy networks play an important role in initiating and facilitating interaction processes between institutions (Friend et.al, 1974), creating and changing network arrangement for better coordination (Scharpf, 1978; roger and Whetten, 1982) of institutional strategies.

Policy networks have been considered as a way of coordinating strategies of actors with different goals and preferences with regard to a certain problem or initiative through the formation of stable patterns of relations between interdependent actors which take shape around policy problems and / or policy programmes (Klijn E.-H. and Teisman G.R. (1997), Kickert J.M. Water. and Klijn Erik-Hans (1997). The development of various innovation policies focusing on the development of university-industry interactions clearly shows the strategic orientation towards solving innovation problem by promoting interactive networks between academics, firms and government agencies. However, the nature of the institution as patterns of behaviors, norms, routines and established practices etc. gives rise to a number of considerations from policy network perspective.

First, due to institutional dynamics and different roles of innovation actors, forming

institutional relations through policy networks need to take into account different roles of actors in the policy networks and the institutional power distributed in the networks. For instance, Bruijin and Heuvelhof (1997) use 'self-referentiality' referring to the norms and culture developed in a particular institutional context which might not be understood by other actors who have not been operating in the same situation. Because actors operate in the network environment tend to use their own languages or similar frame of references that fit into their norms. The institutional dynamics also require innovation actors to react on the rapid changes of environment and take advantages of emerging opportunities, secure new options and resources etc for effective networking. Therefore actors need to negotiate rules and different interests of network members.

Second, networking is not performed at random but operated and structured by action channels (Allison, 1997). In order to be successful, innovation actors have to selecting network members and creating rules of interactions as network members need to know how to interact with each other. Some rules are known and are used consciously, whereas other rules are followed unconsciously (Klijn et.al, 1995). Actors involved in networking need to be aware of the prevailing rules, because contravening them disrupts the relations between actors and can lead to blockades in interaction. In addition, information and knowledge of the rules also makes it possible to actively select and interact with the right contact within networks.

Another concern which is raised as crucial in forming institutional relations is the role of perception in policy networks. Termeer and Koppenjan (1997) argues that blockages in policy implementation through networking are not only caused by conflicts of interests and power relations, but equally by the perceptions of the situation of the actors involved because actors have their own definition of the world that surround them, which consists definition of the problem, their images of other actors in the networks, the nature of their dependency upon others and vice versa. Van Twist and Termeer (1991) reinforce this view by pointing out that, conflicting perceptions and what is more, the reluctance of contestants to adapt their interpretations of the problem situation can be seen as the main causes of blockages in the process of implementing policy.

Managing the conflict of interests requires a full comprehension of the perceptions from different actors underlying the process of network formation, in particular how the

problem is framed (Dunn W.N., 1981) and valued within institutional norms and context (Sabatier P.A., 1988);(Rein and Schon, 1977) and communicated through continuous interactions (March and Oslen, 1976). Only when the embedded social process of perception is better understood may an appropriate strategies can be developed to influence the process of interaction and improve the conditions for interactive networking.

Essentially, the Triple Helix model takes a collective view on the process of knowledge creation and investigates on the process of interactions that are initiated and facilitated for the purpose of knowledge creation between the actors within the networks. The provision of strategic institutional relations within Triple Helix is crucial in terms of offering a channel of interaction between innovation actors, such as introducing rules of communication and information exchanges etc., which are important for the effective implementation of strategies at operation level. In order the achieve the purpose of the networks, network mangers need to achieve the goal through identifying and working with proper actors and resources, keeping actors committed, defining roles of actors and facilitating effective interactions (McGuire, 2002). The interactive networks within Triple Helix need to be considered at both strategic and operational levels.

### **2.2.3 Challenges of Forming Innovation networks**

Much attention has been paid on the challenges facing innovation actors during the process of performing networking. Issues such as building trust relations and shared understanding and learning etc. have been put in the centre of networking practice (Chell. 2000, Hastings, 1996, Harris et.al 1999). Whist managing these issues indeed is crucial for the success of networking, the discussions fail to identify the problems and challenges embedded in the stage of forming networks, such as:

*Why institutions adopt cooperation strategy and form strategic networks?*

*How interactive networks can be achieved through collective actions of innovation actors?*

*How roles of institutions are negotiated, redefined and adapted in the dynamic network environment?*

The main challenges of forming networks at both strategic and operational level are manifest in three dimensions:



### **2.2.3.1 From Go Alone to Cooperation**

Forming institutional relations requires actors to agree on collaboration within the networks to solve the problem that are identified by innovation partners. However, the process of developing a shared vision can be problematic due to different and even conflicting rationalities, interests and strategies. Current networking literature has been emphasized too much on the manager's behaviour on network building and undermined the purpose of forming networks, which is to the great extent pertinent to organizational and institutional context. The key challenge is how to demonstrate 'mutually beneficial solutions' of collaborative networks (Agranoff R.I., 1990) so that various actors' viewpoints are included in the purpose of the networks and the individual purpose as well as the overall network strategy can be pursued in the process of collective actions.

In other words, actors must be prepared to shift their thinking 'individually' from single organizational perspective to 'collaboratively' with other actors and achieve collective action requires the recognition of common interests from network participants. The commitment of network members may be fleeting if the key stake holders and network members perceive little benefit from the network partnerships. Therefore, actors not only have to identify and enroll with proper resources, but also keep other network participants committed, defining roles of actors and more importantly facilitating effective interactions among actors. (McGuire, 2002).

### **2.2.3.2 The Problem of Collective Action**

March and Olsen (1989) argue that many complex patterns of behaviors are based on the use of 'standard operating procedures', i.e. rules concerning appropriate behavior. This means the decision for cooperation lies in a variety consideration of routines. This view is supported by Axelrod (1981) who argues that cooperation does not necessarily have to be either 'taught' or 'imposed'. Rather it may evolve over time through interactions as actors become used to one another. Actors are able to build consensus and agree on the mutual adoption of *rules*. The challenge is how these rules can be created and fostered for the need of collective action. Although trust is considered as important as the basis of forging cooperative relationships, Axelrod (1981) argues that the foundation of cooperation is not solely based on trust, but also the durability of the relationships involved, i.e. actors have to contact each other repeatedly and frequently.

What's more, in the networking context, a single central authority, a hierarchical ordering and a single organizational goal no longer exist. And no actor possesses power to determine the strategies of the other actors (Kickert et.al, 1997). Resources are distributed over various actors who are interdependent on each other in order to mobilize resources for joint action. There is no single dominant actor who can impose its will on others, therefore steering the flow of resources and mobilizing joint actions within networks become the key task for network managers. Management activities are directed to a greater extent at improving and sustaining interaction between different actors involved and uniting the goals and approaches of the various actors (Kickert and Klijn , 1997). It is argued that the interdependency is the main reason that causes interactions between actors in order to seek information, finance, cooperation and support etc. (Klijn, 1997).

However to what extent such interdependency at strategic level is translated into practice has been paid less attention. Hay and Richards (2000) argue that policy makers are situated in a strategic context with perceived strategic interests which might conceivably be advanced through network participation. Whether these actors would continue to think of such perceived desires as representative of their 'true' interest were they in fact realized can only ever be an empirical question. In this sense, 'interdependency' which is regarded as the basis of joint action to some extent only denotes the strategic intention or anticipated scenarios for policy implementation.

### **2.2.3.3 Complexity and Uncertainly**

Implementing innovation through networks is unpredictable and complex. Not only are many actors involved but actor's preferences change in the course of interaction (Klijn, 1997). As a result, network managers cannot predict in advance what outcomes are likely to occur. What's more, because the process of implementation is an outcome of joint actions of actors from different organizational context, the question is to what extent one actor takes into account of other's strategy and reflects on its own. If all actors act strategically, not all the consequences of their actions could be acknowledged or recognized in current and future actions (Giddens, 1984). This means there is a great deal of uncertainly about the consequences and impact of actors' behavior.

The challenges of forming networks are also pertinent to the established institutional rules and procedures. These rules and procedures are vested in the complex institutional interactions through policy networks, people are reluctant to change and adapt new rules and procedures. Thus it is difficult to promote interaction and activate new practices. Existing institutional arrangement will also block the solution of new innovation problems and the acceptance and implementation of new policy (Kickert et.al, 1997). Finally, managing new patterns of behaviours and practices imposed by multi-layers of engagement and different perceptions of actors also require more attention paid on how to organize and performing networking tasks in the dynamic environment.

#### **2.2.4 Summary**

The central concern of this section is how innovation networks are formed for knowledge-based innovation. Although many have argued that innovation network is formed based on common objectives between collaborative partners in terms of sharing knowledge and generating innovation capacities. Little attention has been paid on how the roles of individual partner within collaborative relations are defined, negotiated and shaped during the process of network formation. The policy orientation of developing knowledge-based innovation that is reflected by the Triple Helix model need to be understood both at strategic and operational level. The role of policy networks in facilitating institutional relations at strategic level were explored with particular focus on different institutional roles, interests, and perceptions of actors involved in shaping the strategic purposes of the networks. The main challenges of forming Triple Helix innovation networks were pointed out given the institutional dynamics presented in the Triple Helix model. It should be noted that although the intention of Triple Helix networks from policy perspective is clear, that is to promote interactions between university, government and industry, the strategic intention can be fleeting without effective implementation, which requires innovation actors perform and activate network relationship to achieve the intended innovation outcome.

### **2.3 Implementing Triple Helix Networks**

Forming innovation network structure does not necessarily lead to the activation of relationships between network participants and joint actions. How institutional networks

are activated into interactive relationships is crucial for the achievement of Triple Helix model of innovation.

This section will explore the implementation of Triple Helix from *operational* perspective and identify the key network tasks that need to be performed by innovation actors in order to build up knowledge networks for innovation purpose. Information has been perceived as one of the key sources of innovation. However innovation actors are facing mounting information challenges posed by the uncertainty and complexity of the innovation networks. What information and knowledge are required and how to access to the necessary information through various patterns of communication will be reviewed in this section. In addition, the process of innovation requires effective coordination. The issue of coordination for implementing Triple Helix will be examined and different coordination mechanisms for ensuring effective networking will be discussed.

### **2.3.1 Activating Innovation Networks**

Innovation networks require activation to ensure channels of communication are open up and the relations are maintained (Moore, 1986). Network activation involves initiating interaction processes in order to achieve a particular goal (Kickert and Koppenjan, 1997). The term activation, according to McGuire (2002) refer to a set of behaviours employed for identifying and incorporating the person and resources (such as funding, resources and legal authority) to achieve programme goals. In order to activate innovation networks, a number of key activities need to be performed by innovation actors.

#### **2.3.1.1. Selecting Network Participants**

This means managers need to identify and select the key actors who either possess decision making power or occupy nodal positions and have wider connections within the networks. Friend et.al (1974) suggest that two decisions need to be made during the activation of networks:

First, to decide which link in a network needs to be connected with the exploration of decision making issue. It is argued that the success of network activation not only relies on who are involved in the networks, but also depends on whether the actors involved are willing to invest their time and resources in contributing to the issues concerned, decision-making and problem solving process. Notwithstanding the role of the key actors

involved in performing networking tasks, those who are not involved in networks might not necessarily be less important. As Friend et.al (1974) and Scharpf (1978) point out, the success of this activity also depends on the willingness of those who are not involved to stand on the sidelines.

Second, to decide the nature and amount of information that needs to be sent through these links. It is noted that the volume of information provided to network participants has certain impact on the willingness of actors to participate. As Kickert and Koppenjan (1997) argue that the important issue is which information should be given and how much. This is particular evident in the context of problem solving process. People are more positive towards discussions if alternative solutions are proposed whereas the attitude of participants tends to be negative if only one proposal is put forward.

### **2.3.1.2 Facilitating Communications and Interactions**

Another key task of activation is facilitating communication between innovation actors who otherwise are not able to build up a common understanding on the benefit of networking and interacting with each other. Many studies on innovation networks tend to be underpinned by the assumptions that network participants have already known the benefit of cooperation thereby made decision on participating innovation networks without much consideration on the operational rules, means of communication and roles of individual actors in the networking process. Crozier and Friedberg (1980) suggest it is important that conflict regulating mechanisms are provided to resolve differences of opinions. One of the means of facilitating communication is by influencing the role that each participant may play and the perception one has about the common purpose of the networks (Benson, 1975; Gray, 1989; Lipnack and Stamps, 1994; McGuire, 2002).

Facilitating interactive networks also requires keeping an eye on means of communication (Susskind and Cruikshank, 1987); reducing complexity and uncertainty by promoting information exchange (Gray, 1989; Lipnack and stamps 1994); signalling which resources are necessary to resolve the conflict and making suggestions on how to use them (Moore, 1986); confronting the parties with the perceptions and interests of the outside world and endeavoring to make parties enthusiastic about and getting them committed to the proposed solutions (Susskind and Cruikshank, 1987). Motivation theory suggests that motivated and committed people are likely to be consistent, creative

and energetic for the attainment of goals. In order to improve the interactive relations, network managers need to develop the ability of 'mobilizing behaviours' (McGuire, 2002) to induce individuals and keep a commitment to the networks. The process of interactions is characterized by many 'loops' and steps backwards and forwards (Agranoff, 1986). The key role of the facilitator is to create an environment and enhance the conditions for favorable, productive interaction among innovation actors.

### **2.3.1.3 Brokering**

Innovation requires continuous generation of new ideas from various sources. One of the important types of facilitation is the role of 'brokering'. The importance of brokering activity lies in its ability to tap and utilize the diversified ideas, insights and solutions which are present within the networks, but which without brokering activity would not be mobilized for tackling a problem (Kickert and Koppenjan, 1997). The nature of Triple Helix innovation networks is manifest in the continuous interactions and exchanges between the university, government and industry. However the innovation capacities, as argued, are generated and constructed through the subdynamics of intentions, strategies, projects that underlying the institutional relations (Leydesdroff, 2000). Knowing and tapping different ideas and information embedded in the dynamic innovation networks are essential for knowledge creation. Especially when the uncertainty and complexity posed by the dynamic networking environment make it increasingly difficult for innovation actors to effectively access, evaluate and utilize information for the purpose of knowledge creation. These concerns give rise to more considerations on the differences between information, knowledge and innovation networks.

### **2.3.2 Information, Knowledge and Innovation Networks**

The success of innovation is highly dependent on information and knowledge which are the key successful elements of developing knowledge economy ((Brown, 2002; Komninos, 2004; Nonaka Ikujiro, 1994). Every aspect of innovation organization depends on information processing of one form or another (Morgan, 1997, Castell, 1996). The ability of knowledge creation on one hand relies on the information that actor is able to receive from the context in which they are operating, on the other hand, it is associated with the abilities of innovation actors to evaluate and assess the information that is useful for knowledge creation. Therefore, the process of generating innovation capacities cannot be separated from the process of developing and managing information and knowledge (Newell et al., 2002) and understanding the process of knowledge-based innovation

requires the appreciation of three important and inter-related networks: information networks, knowledge networks and innovation networks.

### **2.3.2.1 Defining Information and Knowledge**

To make a distinction between information and knowledge networks, it is important to define the relationship between information and knowledge. The meaning of knowledge is often explained through the comparison of the relationships with data and information. According to Glisinan (1984), data are simple observations about phenomena; information is data that will make a difference, whereas knowledge is information that provides guidance for action by describing relationships between means and ends. Data becomes information when it is assigned definite relational qualities or quantitative (an element of a set or subset). Hunter (1999) also provides a similar taxonomy by arguing that data are facts, observations, or measures that have been recorded but not but into meaningful context. Information is data that has been arranged in a systematic way to yield order and meaning and knowledge is information in mind, in a context which allows it to be transformed into action. To explain the meanings by using a metaphor, Hunter (1999) put it, a single musical note is data, a series of notes arranged into a tune if information and a musician is able to play a tune because of his knowledge. Therefore the nature of knowledge itself embodies practice and experiences that are socially embedded.

Clearly there are many types of knowledge and the concept of knowledge has been studied from different perspectives. Nonaka and Takeuchi (1995) in their book *the Knowledge Creating Company* explain how innovation is conducted through knowledge creation process through the transfer between tacit knowledge to explicit knowledge. It is argued that knowledge can be divided into two broad categories: explicit knowledge and tacit knowledge. The former include:

- Scientific knowledge, that is theoretically grounded and publicly reproducible knowledge used to transform material and social process;
- Knowledge defined as intellectual property such as patents, copyrights, trademarks etc.
- Routinized knowledge, sometimes designated as 'information' or 'data' that can be gathered, aggregated, marked and disseminated by various means and through various institutional routes.

The other kind of knowledge, tacit knowledge refers to something that cannot be explicitly codified but which rests very much in implicit personal or institutional practices (Polanyi M., 1967).

O'Connor et.al (2002) further explains the nature of knowledge by suggesting knowledge is an analytic operation on information. It is argued that knowledge is mediated process generalization and can be understood as an evolving synthetic or cultural consciousness. This operation should be understood as an interpretive rather than descriptive process. In this respect, the context of information becomes important (Carey, 1991, Agrawal A. and Henderson, 2000; Tidd, 2001; Brown and Duguid, 2002, O'Connor et.al, 2002; Molina-Morales, 2002; Dankbaar, 2004; Amaravadi et.al, 2005).

### **2.3.2.2 Information, Knowledge and Innovation Networks**

The network approach towards information and knowledge is more than a description of the flow of information and the differential availability of information. It is an expression of the knowledge that influences the capability of individual actors, with more information leading to more relations (Kogut et al., 1993). Based on this understanding, Kogut et.al (1993) distinguish between information and knowledge networks as: '....information networks consist of identifying who will co-operate and who has what capabilities. ', whereas 'knowledge networks not only consists of information but also of the know-how regarding cooperation'. This view is supported by Karlsson (1994), who argues that knowledge is in fact the effective exchange of qualified information and presupposes communication or direct face-to-face contacts between individuals. Comor (2002) argues that information does not become knowledge as a result of some kind of innate and progressive mechanism through which the more information we have, the better our decision will be(Comor E., 2002). These are shaped by socialization processes involving various institutions, organizations and technologies that mediate norms of thought and behaviour (Comor E., 2002). It is when information about one context is integrated with information about other context, that this expansion-within-generalization becomes knowledge to the actors working in those different contexts.

Johansson (1991) further argues that innovation networks proceed from information links between developer, user and other actors in a knowledge networks whilst innovation



networks revolve around the development of new technical solutions, new equipment and knowledge in contact-intensive interaction. The technology transfer and commercialization activity within Triple Helix networks between university-industry are clearly a demonstration of the configuration of information, knowledge and innovation networks. Such network configuration is further illustrated by Charles and Howells (1992) who identify the different content involved in information, knowledge and innovation networks. It is pointed out that:

- Information transfer – comprises data, documentation, software, standards etc.
- Knowledge transfer – requiring an understanding of the origins and potential impact of technology or processes, skills know-how and relevant policy issues and the ability to adapt the diffuse innovation
- Hardware transfer – broadly interpreted as the transfer of devices, equipment, parts, materials and entire information system.

Therefore innovation networks should be understood as originating from the creative combination of know-how through knowledge networks that are supported by flow of information. Notwithstanding the acknowledgement that knowledge is more than information (Hunter, 1999; Dretske, 1981; Nonaka, 1994; Davenport, 1998). The ever-expanding information is being made available doesn't necessarily mean that we are becoming more knowledgeable than before. The dynamic nature of knowledge itself and the networks associated with new knowledge production has sparked the growing interests and debate on how the process of networking is coordinated.

### **2.3.3 Coordination Mechanisms**

One of the major concerns of performing Triple Helix innovation networks is how to tackle the problem of collective actions of innovation actors from different institutions. Innovation networks are considered as successful if they facilitate and promote cooperation and prevent blockages which obstruct cooperation through effective coordination. Various coordination mechanisms within innovation networks have been developed by theorists (Bellini N., 2000; Klijn E.-H. and Teisman G.R., 1997; Bruijn J.A. de and Heuvelhof E.F. ten., 1997; Chisholm D., 1989; Davids G., 1995). However the growth of interests in the concept of coordination has not yet been accompanied by a clear definition (Petters B.G., 1998). It is pointed out that coordination itself is

multifaceted and can be approached from many different angles (Sanchez, 2000). This section will explore a number of key dimensions of coordination in the networking context.

### **2.3.3.1 Coordination through Interaction**

Traditional ways of control and coordination has been associated with hierarchical structure and direct command between actors (Kochen and Deutsch, 1980). However within the horizontal and flat network structure, traditional command and control are no longer appropriate (Chisholm D., 1989). It is argued that the degree of coordination in the networking context is associated with how actors interact with each other within networks (Petters B.G., 1998). Proximity relations that are developed through networking is an important feature of most innovation process (Cooke, 1998). The link between social networks and innovation is evident through collaboration between firms during new product development activities (Edward et.al 2004). For example, in the regional innovation context, resources to create innovation and knowledge sharing are often centered in science parks consists of business clusters around universities or large R&D companies. The nature of the partnerships and innovation networks often takes an informal rather than formal way. Therefore the network coordination mechanism to the great extent relies on quality of relationships developed within innovation networks based on effective interactions and communications.

Uncertainty and increasing complexity are the key nature of modern innovation process (Dosi G., 1988). Therefore social interaction through networking has been recognized as an important facilitator in the process of innovation (Burt R.S., 1992). Innovators do not work in a vacuum, they are embedded in networks of social relations.

Social influence has been argued to play an important role in network governance. For instance, Jones et.al (1997) identifies four social mechanisms in coordinating network relationships: restricting access to exchanges, macro-culture, collective sanctions and reputation which act to coordinate and safeguard exchange. Hofstede (1994) argues that high performance can be achieved through control only if it has influence on how things are done, control without support is an extremely blunt weapon. It is the linkages between members and the degree of interdependence between each other that cause outcomes of the network (Thorelli, 1986)

### **2.3.3.2 Building Trust Relations**

Analyzing social aspect of coordination points to the need of thinking about trust relationship, which has been seen as a key enabler of cooperative behavior in the networking environment (Granovetter,1982; Holland, 1998; Handy, 1995; Kramer and Tyler, 1996; Harris, 1998; Nandhakumar, 1999; Sarker et.al 2003; Dodgson, 1996; Lane and Bachmann, 1998; Gossling, 2004). Despite of increasing attention from management researchers, the notion of trust is argued to be the most difficult concept to handle in empirical research because of the diverse definitions of trust used in each discipline and multitude of functions it performs in the society (Misztal B.A., 1996).

The origins of trust enabled transactions between strangers to be more predictable and more reliable and usually involved an institution as a medium against which the transaction took place (Knights et.al 2001). Trust has not only become regarded as an important coordination mechanism (Bradach and Eccles, 1989), but is increasingly being viewed as a precondition for superior performance and competitive success in the new business environment (Ring an van de Ven 1992, Sako, 1992), in particular, the social context and expectations are recognized as important in the process of developing trust between individuals and organizations. Granovetter (1982) argues that trust relations embedded in particular social relations and the obligations inherent in them. Thus common values and norms of obligation can develop in a long-standing relationship where trust was initially created in an incremental manner but where value-consensus emerges from the relationship.

Nandhakumar (1999) analyze trust from personal relationship aspect and points out that personalized trust relationships are essential for maintain networking relations and such relationships are normally established through face to face interactions and socialization. In terms of forming trust relationships, the issue of space and working across organizational and geographical boundaries are emphasized. It is argued that trust relationships may be based on the abstract structures between innovation actors when collocation is impossible. However, to maintain trust requires continuing reproduction through the interactions between network participants (Nandhakumar J., 1999). In this sense, creating conditions and constructing opportunities for such interaction between innovation actors becomes the key for coordinating effective knowledge networks.

Trust as an intangible asset is seen as the basis for knowledge-sharing (Newell et.al ,

2002). The intangible assets, or referred as social capita embedded in the network process is crucial to facilitate cooperation and coordination (Sabel C. F., 1990) and learning and exchange where interdependence between innovation actors that generates an innovative system or an innovation cluster (Simme, 1999, Feldman et.al, 2005; Acs 2000). Creating these intangible assets requires quite deliberate action on the part of firms and public agencies (Cooke and Morgan, 1998)

### **2.3.3.3 Strategic Leadership**

Despite social aspect of control based on interactions and trust-based relationships, it is point out that the use of purely social mechanisms of control is limited when the network is global and complex, an inspirational leadership is required to enhance motivation and commitment in the network organization ( Poole et.al, 1999; Pettigrew, 2000c). Shifting to a more flexible, adaptive and locally responsive organization did not imply giving up tight control of operating process, rather, the new network form of organizing demands even tighter controls that, at the same time, enabled flexibility and fostered innovation (Applegate L.M., 1999). This requires leadership in building up formal frameworks and incentive systems as additional control mechanisms to coordinate between groups in the network.

The strategic leadership is undoubtedly important in defraying excessive ambiguity and complexity (Pettigrew, 2000a). The achievement of the mission depends on the shared understanding and mutual support. Hackman and Walton (1986) argue that in the process of networking, it is important that goal is infused with a sense of mission, which makes the uniqueness of organization clear, gives direction to efforts to meet the goal, and energizes members to give their utmost. The effectiveness of networking is determined by the capacity of actors to demonstrate leadership in interactions by devising new options, speaking out for them to their organizations and in addition by succeeding in getting their organization to keep to the agreed procedures (Kickert and Koppenjan, 1997).

However, the diffusion of the network organization in the innovation process may militate against the effective exercise of leadership. Gordon (1994) makes the point that a limitation of the interactive organizational form is diffusion of responsibility across networks of actors. There is also a question of whether in the fast changing environment network members have sufficient time to attend to a leader or develop a sense of mission.

It is believed that strong and inspirational leadership is needed for an interactive organization to be effective. This implies that the facilitator role may often extend beyond merely assembling and coordinating units to providing leadership (Poole et.al, 1999). Facilitating interactions for knowledge creation not only needs to create consensus between actors regarding a joint course of action, but also needs to establish support for these ideas. And this requires leadership qualities and also the commitment from network participants. It is argued that the success of coordination within network context largely depends on the quality of leadership and the commitment power possessed by the actors involved (Kickert and Koppenjan, 1997).

What's more, it is pointed out that in the networking context leadership will shift from focus primary on what is visible and tangible, to mapping the invisible territory, i.e. to develop a deeper level of knowing, a deeper level of awareness (Author et.al, 2002). As Winslow (2002) puts it, 'the more we learn from each other, the closer we work.'

#### **2.3.4. Summary**

The central concern of this section is to explore the operational issues related to the implementation of Triple Helix innovation networks. Many studies on knowledge-based innovation tend to treat the establishment of strategic networks as a pre-fixed condition for network operation with little consideration on how the networks are activated through various tasks and activities performed by innovation actors at micro level. Innovation networks cannot function themselves unless they are activated by actions of innovation actors. This section described a number of key tasks for activating innovation networks including the selecting of appropriate network partners, facilitating interactions and communications and brokering resources and information between actors.

Although consideration on these functional tasks in performing networks is necessary, the networking tasks cannot be completed successful unless actors can access to the relevant information. It is noted that information-processing has become one of the most important activities for every aspects of organization (Morgan G., 1997). In the context of innovation, information acts as the basic element for knowledge creation and knowledge creation not only requires relevant information, but also needs to take into account the contextual factors. Finally, developing knowledge-based innovation not only requires facilitation and support, but also effective coordination. A number of key coordination

mechanisms were examined with particular focus on the means of interaction, trust and leadership in the context of networking.

## **2.4 Managing the challenges of Triple Helix networks**

The strategic orientation of reinforcing collaborations and interactions within Triple Helix innovation networks might remain an intention at strategic level if the challenges at micro and implementation level are not managed and addressed properly. This section will seek to explore the micro dynamics and challenges of facing innovation actors when they enact their role as facilitators, brokers as well as performers.

### **2.4.1 Multi Processes and Interactions**

Networks do not function unless they are performed and activated. Implementing knowledge-based innovation requires actions to be taken and tasks to be performed as well as processes to be managed. These processes and tasks are also linked to more specific objectives and strategies of individual actors. Appreciation of the dynamics presented by Triple Helix requires special consideration on the processes and interactions at different levels.

O'Toole et.al (1997) have distinguished three levels of managing activities in the networking context: strategic, operational and cross functional.

#### **Strategic level**

The strategic level of activities refers to the initial network formation stage where senior representatives from different organizations come up with shared problem definitions and developing agreed-upon courses of action which lead to the creation of a new initiative or programme that aims to tackle the problem. It is pointed out that the network participants are valuable initially not as 'free-floating' individuals but as 'representatives' of an organization that controls part of the programmatic action or relevant resources. And the fact that interactions within and through the resulting the network may take on another dynamic of their own is another matter.

#### **Operational level**

At the operational level, the activities involve the real world interactions as well as the creation of operating plans that provide the framework for actions to achieve programme goals. It is at the level of the participating organizations that the network commitment

must be translated into concrete operational activities aimed at (or carried out in conjunction with) the ultimate target groups of the joint programme effort. Whilst the strategic partnerships defines the structures of the networks in which each member will operate with regard to the programme implementation, the actual operation of networking activities will usually be handled by the street-level bureaucrats working within the network-relevant functions of individual organization (O'Toole et.al 1997). It should be noted that while the study of innovation networks within Triple Helix is focused on the interactive process of a variety of actors, the impact on the performance of individual actors from dynamic of individual organizational structures and changes should not be ignored.

### **Cross-functional level**

The term 'cross-functional' in the network context refers to the complex project environment in which innovation actors are operating. Innovation requires actors being responsive and flexible to changes and new ideas. Therefore it is hard to define and fix individual roles in the network operation. The changing context of operation and emerging opportunities often require network managers to follow up ideas and develop new project cross department and organizational boundaries in order to exchange information, mobilize resources and coordinate the daily operational decisions of individual actors involved in the collective actions. Different processes of innovation networks may leads to different patterns of interactions given different rules, norms and behaviors embodied within different institutions. These norms and rules provide the basis of conduct and to the great extent shape the form of organization and means of communication in the process of interactions between innovation actors.

In order to understand the nature and patterns of these interactions, it is necessary to analyze how activities are organized and managed at different levels. Neither strategic interactions that provides overall framework of implementation nor operational interactions that shape the outcome of networking can be neglected from the research process. The defining character of Triple Helix from institutional approach implies the importance of context in which interactions are derived. The interaction at strategic level plays an important role in terms of creating constrains or opportunities that shape the actions at operational level. Because decision-makers at strategic level can help to define formal roles in terms of allocating resources, authority for initiating action and laying down the rules and procedures to be followed (O'Toole et.al, 1997). These 'rules of the

game' (Klijn et al., 1995) and procedures can be perceived as strategic interactions that set conditions under which implementation at operational level of interaction will be conducted. As a result, managers involved in performing networking tasks need to operate within the 'rules of the game' set by strategic decision-makers and the perceived and common objectives at top level.

## **2.4.2 Managing Change**

For contemporary managers, change has become the 'Zeitgeist'. Its acceleration and growing complexity weigh heavily on the structure, interpersonal dynamics and effectiveness of organizations (Thomas and Bennis, 1972). In the knowledge economy, it is evident that changes involved in creating the knowledge-based innovation come from various perspectives and at different levels and the nature of these changes are described as transformational both between institutional boundaries and within institutions including the creation of entrepreneur universities (Grant Harman et al., 2004, Lazzeroni and Piccaluga, 2003, Vogel and Kaghan, 2001, William Z. Todorovic et al., 2005, Etzkowitz, 2004) and changing role of government as facilitator and broker in supporting regional innovation (Da Silva, 2001, O'Brien, 2000, Beesley, 2003). However the key challenge is how the 'transformational changes' described in the Triple Helix are managed.

It is increasingly recognized that 'change at the bottom is no longer expected to come about through change at the top', although 'change at the top is called for consolidate and develop the achievements of initiatives at the bottom' (Lipietz, 1992). This view is also supported in Triple Helix approach to create the knowledge-based innovative region. It is argued that new policies and initiatives are created from the bottom as an outcome of 'collective entrepreneurship' through collaboration among business, government and academic actors by academics and industrial actors (Etzkowitz and Klofsten, 2005). It is further emphasized that these initiatives are self-sustaining dynamics in which the role of academia and government appears to recede as industrial actors come to the fore and a lineage of firms is created.

Understanding the necessity to change doesn't necessarily mean the understanding on what it takes to bring it about (Beer et.al, 1990). The implication here is clear that the change initiative from the top needs to take into considerations of the diversity and dynamics at bottom level in order to ensure the successful implementation. The diversity



and dynamics of changes involved at the operational levels not only means innovation actors increasingly taking each other's roles between institutional spheres, but also include building up relationships between actors, managing distribution of resources (e.g. information, expertise, power), interactive procedures, rules (e.g. new ways of communication), perceptions and values in the process of knowledge creation. Managing these challenges require not only the abilities of identifying and understanding the underlying assumptions, norms and political interests in the networking environment, but also the ability of creating an environment that support changes and risk-taking at the operational level (McLoughlin, 1999)

Although making change is one of the key processes of implementing innovation policy, the implementation of these innovation policies tend to follow traditional linear way of managing change, such as announcing new initiatives, creating the team or organizational structure and implementing tasks. The dynamic nature of networking involved in creating knowledge-based innovation requires innovation actors adapt or change their own strategy in the networking context to as well as interact with each other to form effective collaboration relationships. After all, change doesn't mean a series of programmes, announcement of new initiatives and quick set-up of organizational structures. Change in the organizational chart does not necessarily lead to the way people carrying out their tasks or equipped with the necessary skills to cope with the new situation. The effectiveness of change lies in the process of task alignment through networking in which new ways of working and new procedures are perceived, judged, appreciated and finally accepted by those who are involved in the changes programmes (Pettigrew A.M. and Whipp R., 1991).

The common attitude to change lies in the belief of theory of change which usually starts from changing people's attitude towards new way of working. It is argued that the fundamental change take places only when people are put in the new situation and imposed by new roles, responsibilities and relationships (Buchanan D. and Boddy D., 1992). As it is noted, successful change efforts focus on the work itself, not on abstractions like 'participation' or 'culture', in fact individual behaviour is powerfully shaped by the organizational roles that people play (Beer et.al, 1990).

Given the complexity and dynamics of changes involved in developing knowledge based innovation, it is crucial for innovation actors to develop necessary skills and knowledge

required to recognize new opportunities as well as adapt changes. If knowledge creation is regarded as the ultimate purpose of innovation and managing change is crucial to achieve this purpose, then learning is an important process that helps to develop the skills and capacities for managing change.

### **2.4.3 Building Learning Capacity**

Change is about learning (Beer M. and Eisenstat R.A. and Spector B., 1990). Innovation and change occur through the development of new metaphors as concepts used to explain and visualize situations are 'displaced' to a new situation (Schon D., 1963). This has created what is termed as 'learning perspective' of managing innovation. It is argued that knowing how to develop and deploy technological competence is as important a learning process as the actual knowledge within a particular technological competence (Bessant et al., 1996).

#### **2.4.3.1 The Social and Organizational Perspective**

Existing theories of learning are to the great extent originated from social and organizational perspective of learning and linked to the field of knowledge management literature. For instance, Nonaka (1994) developed a dynamic theory on knowledge creation within an organizational context by explaining different processes of knowledge transfer between explicit and tacit knowledge. Hock-Hai et.al (2006) explore the learning capacities within an organization and point out that the learning capacities for an organization is associated with the organizational climate for learning, the orientation for using knowledge and knowledge sharing within organizations.

Building learning network to facilitate transfer experiences and learning around it is important to enhance firms' ability of creating new knowledge and innovation (Bessant et al., 1996). The role of social networks in facilitating learning is addressed in sourcing science knowledge to industry (Liebeskind J.P. and Oliver A.L. and Zucker L. and Brewer M., 1996). It is argued that the flexibility and informal nature of social networks help to increase learning between firms and help to respond to the rapid changes in the technology market (Camagni R., 1991, Castilla E. and Hwang H. and Granovetter E. and Granovetter M., 2000, Yeung H. W.C., 2005). However the report from Asheim and Coenen (2005) indicate that knowledge base within regional innovation system needs to be differentiated between analytical (science-based industry) and synthetic (engineering-based industry), which tend to have different mix of skills and knowledge to develop

different competence in the global market. Therefore the learning pattern developed from a particular industry sector, in the case of bio-industry described by Liebeskind et.al (1996) might not be appropriate to reflect the learning experiences of other sectors. In addition, although social networks may facilitate informal learning to some degree, the learning through formal procedures and rules should not be undermined in terms of formal meetings, events and information exchanges.

The social and organizational perspectives surely provide useful insights on how individuals and organizations can learn from each other within a specific context and supported by different processes of knowledge creation. From this perspective, learning is understood as activities of individuals or organizational strategies. However, developing knowledge-based innovation in the regional context, which involves diverse actors from different institutional context, has created new challenges of learning for generating innovation capacities in a region. Managing these challenges require new approach to learning.

#### **2.4.3.2 Learning as a System of Interaction**

The idea of learning as a system derives from the institutional approach and focus on how learning occurs through the interactions of innovation actors within the system (Cooke and Morgan, 1998). However it is pointed out that learning system is different from innovation system in the sense that it is the first step to innovation. The system approach of learning also fits into the interactive nature of knowledge-based innovation within Triple Helix, which suggests that the capacities of innovation is generated from an endless transition of innovation networks across relevant boundaries.

Cooke and Morgan (1998) define two parts within the learning system: upstream (close to the point of origination of the innovation or idea) and downstream (i.e. near –market) and argue that developing an effective knowledge-based innovation require the close interaction between the upstream and downstream. This point is reflected in the Triple Helix networks where university is perceived as the stock of knowledge and industry as the place of knowledge application. The role of government is to promote and facilitate collaborations between university and industry. Notwithstanding the importance of creating a supportive environment for learning, the drawback of this approach lies in the assumption that innovation actors have already had the capacities to learn and are ready to accept and utilize new knowledge.

Review on the key functions and roles of actors involved in creating knowledge-based innovation shows that building up learning capacities for knowledge creation require the following aspects:

*Orientations for learning:* Despite many government initiatives and support for innovation and knowledge, research shows that the success of the initiatives is dependent on the innovation needs of firms and specific knowledge and skills associated with certain sectors. As suggested by Simmie (1997), individual firm strategies may work against the formation of regional innovation system. Thus developing the learning capacity requires deep understanding on the need and orientation for learning within industries.

*Orientation for interaction:* Evidence from high performance region shows that interaction between actors through social networks is the key nature for knowledge creation. For instance, Silicon Valley has dense social networks which encourage entrepreneurship and experimentation. Companies compete intensively whilst learning from each other. However, in contrast to Silicon Valley, the Route 128 region has distinct boundaries and corporate hierarchies between firms, customers and competitors (Saxenian A., 2000). The contrast between the two high performance regions clearly indicates interaction is not necessarily a pre-condition for learning, rather it is the local and institutional context that play an important role in shaping the outcome of innovation.

*Orientation for knowledge commercialization:* The role of university in developing knowledge economy has been widely acknowledged. Although a number of studies have been conducted in attempt to promote the idea of 'entrepreneurial university', the tendency of universities become more commercial driven for knowledge production has been challenged by the conflicting roles between teaching and research as well as the identity of traditional universities. As one of the key elements of Triple Helix networks, the attitude and abilities of universities to adapt the new environment play an important role in developing the learning capacities for knowledge-based innovation.

*Orientation for knowledge application and diffusion:* One of the key features addressed in new production of knowledge is knowledge application. In order to develop new knowledge that can be applied in the market, researchers need to work closely with business managers and understand the needs of customers in the fast changing global market. Thus the innovation capacities to the great extent depend on how far firms

recognize the importance of knowledge application to help their competence in the global market thereby being responsive to the needs of learning.

Developing the above four aspects of learning also requires support from the institutional environment. It is pointed out that to improve the potential for learning, organizations need to build a conducive learning climate/culture (Sohal et al., 2002). A learning culture, according to Macher (1992) is one where people were creative in all their relationships and experiences. Managers need to be encouraged to take risks and try out new ideas. In particular when innovation actors work across organizational and institutional boundaries, cultural tolerance and empathy is a basic condition for communicative openness and learning (Boutellier R., 1998). Melding different cultures together when working together is also a key learning for actors working in the networking context across boundaries (Pauleen D.J. and Yoong P., 2001).

Finally, learning should not be blind. Instead, learning should be focused to achieve its purpose. One way of defining the outcome of learning, as Cooke and Morgan (1998) argue, is to look at the change in a person's or organization's capabilities or understanding. Therefore for the successful implementation of Triple Helix networks in the regional context, the accomplished learning system will be the one that has the capabilities of generating innovation capacities.

#### **2.4.4 Summary**

This section presented a number of key challenges anticipated during the implementation of Triple Helix networks for knowledge-based innovation. The complexity of interactions at different levels was addressed when actors need to develop collaborative relationships at strategic, operational and cross-functional level in order to allocate resources and mobilize collective interactions. During the dynamic networking processes, managing change has become an unavoidable task for actors. It is noted that while being a source of risk reduction, innovation networks may expose collaborators to new sources of vulnerability associated with building and managing network relationships and organizational forms (Harris L. and Coles A.M. K. and McLoughlin I.P., 1999). The process of interactions between university, government and industry to a certain degree requires the transformation of existing institutional arrangement into the new situation. Coping with new situation and adapting to new roles requires changing traditional mindsets and new ways of thinking. Change itself is a reflection of learning from past

experiences and obtaining new knowledge. It is from this aspect that the significance of learning was emphasized and learning as an interactive system in the regional context was analyzed in relation to the functions and roles of actors involved in the process of developing learning capacities.

## **2.5 Network Approach to Policy Implementation**

Existing literature on knowledge-based innovation tends to focus on the prescribed conditions in knowledge creation, less attention has been paid on the process of implementation and how these conditions are developed to enable interactive innovation.

### **2.5.1 Traditional Policy Implementation**

Policy implementation requires the cooperative efforts and involvement of a variety of innovation actors. No individual actor possesses sufficient authority, resources and knowledge to enact – let alone achieve – the intended outcome. Instead, it requires the interactions between key actors a multiple level to build up relations and share information and resources to create new knowledge.

Traditional approach to policy implementation has been considered as different stages of actions that follow certain pre-fixed orders. Based on this approach, the execution of initiatives is characterized by the formation of strategic intention. Information is used for strategic planning and decision making is for the purpose of long-term implications of the initiatives rather than taking into account the operational practice. Thus, the implementation phase is considered as a non-political, technical and potentially programmable activity (Kickert J.M. Water. and Klijn Erik-Hans, 1997). The weakness of the conventional approach lies in the assumption that information is readily available for implementing programmes and solving existing problems. In addition, Kickert and Klijn (1997) indicate that the values and interests of parties involved in implementing the programme are neglected and their individual strategies are disregarded.

More importantly, the process of forming strategic networks and its impact on the operational and individual interactions are undermined. Consequently, the criteria for the implementation is the attainment of programme goals and the causes of the failure usually are regarded as coming from the resistance from implementation actors, lack of control and coordination as well as lack of rationale of information etc. without the

analysis on how the programme goal is formatted and agreed in the first place by the network participants and how innovation actors are involved in the process of building networks for knowledge creation.

In this context, traditional approach of managing policy implementation offers little practical help in terms of understanding the dynamic situations where the key challenge is not within a single organization but managing across boundaries in the networking context. Therefore new perspective of implementing knowledge-based innovation is needed to address the dynamics of knowledge-creation and challenges facing those performing knowledge networking tasks.

### **2.5.2 Network Approach to Implementation**

The network approach of implementation takes into consideration of the dynamics and complex processes involved in the Triple Helix model of innovation. Although Triple Helix as an analytical framework, provides a useful strategic tool in understanding the core elements of knowledge-based innovation and proposes the analytical focus on the interactions between these elements, it has been criticized as to the model fails to offer practical implications on how it works in reality (Shinn, 2002). The network approach of implementing policy will enable actors to understand the dynamics and complexities of interactions. It can also provide a practical operational guidance on how to manage different interest and roles of innovation actors. Based on the discussions of the key concepts related to networking and careful examination of the current literature, the appropriate implementation of innovation policy needs to consider the following important processes from network perspective.

First of all, the pre-stage of forming innovation policy refers to the driving forces from the external environment and changes evolved from knowledge economy. The pre-stage is important in terms of providing the rationales of developing new strategies for change. It also plays an important role in terms of providing information for decision makers to define the innovation problem through the interpretation of the changing environment in order to make a strategic decision on how to solve the problem.

Secondly, network formation includes the process of defining innovation problem, enrolling institutional partnerships and agreeing on strategic goals for knowledge-based innovation. The process of network formation not only serve the purpose of developing

new initiatives for change, but also a process of reconfiguration of existing network structures and resources to achieve new goals. The importance of network formation lies in that it provides rules and procedures of interaction at institutional level although the implementation of these rules depends on the perceptions of individual innovation actors and the nature of the institutional relations.

Thirdly, implementing networks is a fundamental process of knowledge-based innovation. Although many have argued on how to build up and sustain network relationships, the analysis on networking activities presupposes the establishment of networks with agreed common interests and roles and responsibilities. How innovation actors develop their new roles in the network context and manage the perceptions of others has not been well addressed. Thus it is essential that the different roles played by innovation actors and how these roles assist the process of interactions and coordination are understood. Another important process is managing the challenges posed by the dynamic innovation networks, in particular the critical issues emerged from managing multi level of interactions across organizational boundaries. Only when the complexity and dynamics of these issues are fully appreciated and understood, can learning occur to help to improve existing operation and develop initiatives for new innovation opportunities.

### **2.5.3 Summary**

The network approach to innovation policy implementation offers theoretical elaborations on the dynamic context, context and processes of knowledge creation and significant challenges facing innovation actors during the process of interactions. The processes described above are profoundly collaborative and influenced by each other. The network approach of studying Triple Helix opens up a variety concepts and issues related to creating knowledge-based innovation that remain to be examined and tested through the empirical research. The key concerns include:

- How partnership networks are formed within Triple Helix and how the nature and process of network formation, and the roles played by institutional actors have an effect on the strategies of embarking on the knowledge-based innovation.
- How the variety of innovation tasks are performed by individual actors through enacting different roles in the process of networking.
- To what extent the propositions presented in Triple Helix model for knowledge-based innovation help to bring about what it should entail i.e. knowledge creation



and enhance innovation capacities in a region.

- What are the key challenges face those who work on day-to-day innovation activities when engaging with the dynamic networks and relations and how innovation actors develop learning as well as managing these challenges.

## **2.6 Conclusion**

Chapter 2 explored the implementation dynamics involved in the Triple Helix model for creating knowledge-based innovation. A brief review on existing network literature was conducted at the beginning of the Chapter. It is argued that networks is not a map of discernible reality, but as a way of conceptualizing the process in which innovation actors connect and interact with each other to construct effective relationships based on trust and learning. Thus the remaining of the Chapter focused three key aspects of creating knowledge-based innovation: network formation, performing networks and managing the network challenges. Finally, a number of questions were raised based on the critical issues identified in the implementation process. These questions open up considerations on the design of empirical research and developing the appropriate research strategies, which will be discussed in the next Chapter.

# Chapter 3 Research Methodology

## 3.1 Introduction

The overall purpose of this chapter is to outline the research methodology of the current study and the rationale behind the current research design which entail the strategy for conducting the empirical research.

Section 3.2 introduces the case study strategy which is adopted in this research. This will include rationale of the research strategy and theoretical underpinnings, unit of analysis, the number of cases, data collection methods and discussing the issues that were taken into account when presenting the case study and finally describing how the case study will be analyzed. Section 3.3 will present how the case study was conducted. Finally, the limitation of current research is discussed, which is followed by conclusions.

## 3.2 Case Study Strategy

Researchers have different beliefs and assumptions about the world when conducting a piece of research. These beliefs and assumptions are fundamental to the way overall research is designed including the choice of research strategy and adoption of the appropriate methodology. Case study as a research strategy focuses on the understanding of the dynamics present within single settings (Eisenhardt, 1989). A case study is researching a situation where the phenomenon and the context are entangled but this entanglement is pertinent to the study. As a research endeavour, the case study contributes uniquely to our knowledge of individual, organizational, social and political phenomena (Yin R.K., 1994).

A case study can be positivist based on quantitative method or interpretive which focus on qualitative approach. Qualitative case study is characterized by the main researcher spending substantial time, on site, personally in contact with activities and operations of the case reflecting revising meanings of what's going on (Stake R.E., 1998). A case study strategy is informed by the assumptions inherent in a number of different theories which are used as a valuable guide for the conduction research and

analysis of data collected and where relevant will be used to derive abstractions and generalizations. According to Sayer (1984), theories should be as a set up conceptualized rather than ordering framework. The appreciation of theory-laden character of observation, the interdependence of sense and reference and the indispensable picture carrying metaphorical content of the language should also be taken into account in order to design a realistic approach to solve the research problems. Stake (2000) further points out that a case study is not a methodology choice, but a choice of what is to be studied. The current research adopted qualitative case study strategy for a number of philosophical, theoretical and practical reasons.

### 3.2.1 Rationale of Case Study

This session is to present, evaluate and prove the validity of the case study strategy that was used in conducting the current research project. Figure 3.1 describes interlink between the theoretical assumptions that underpin the current research.

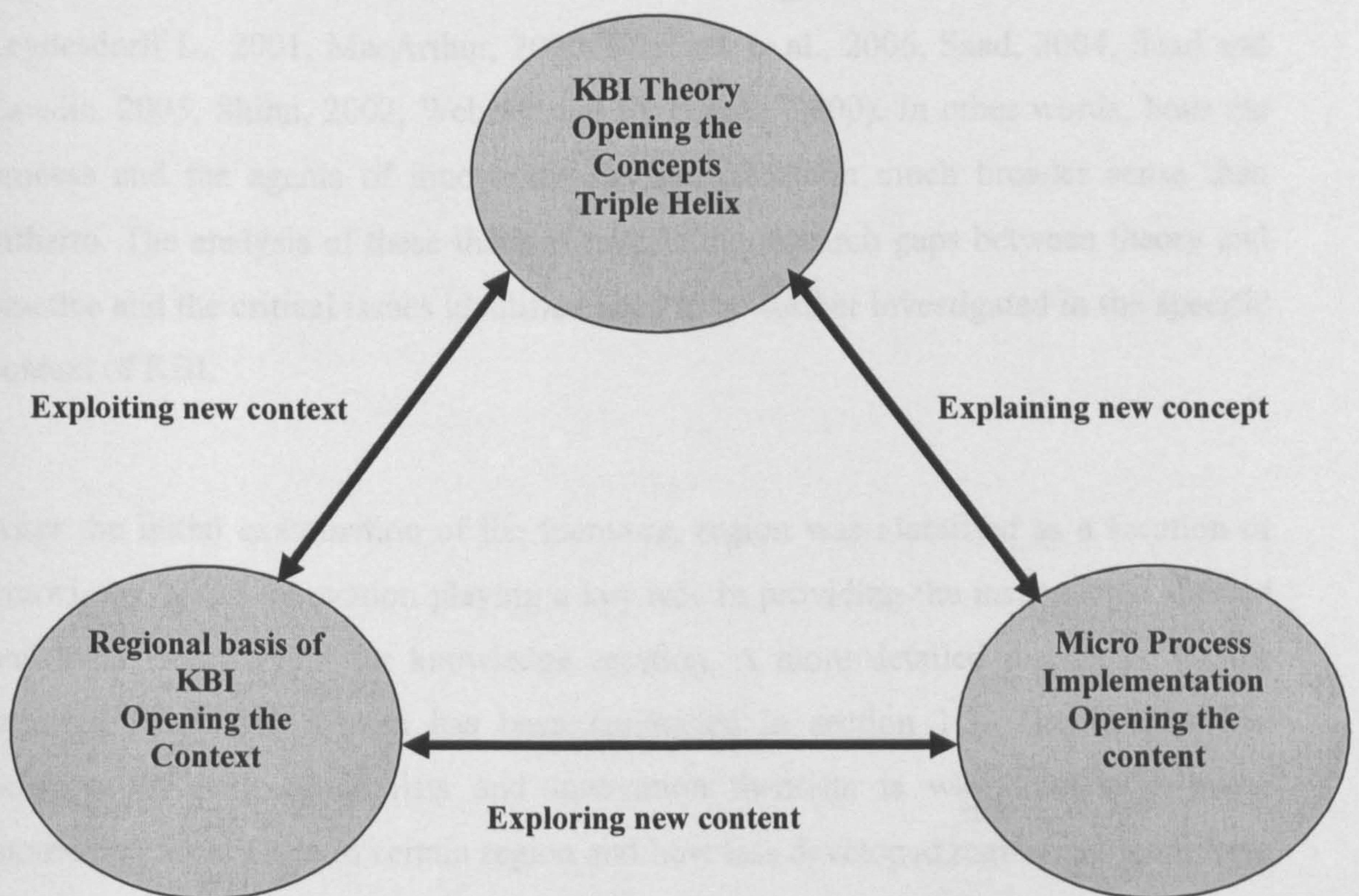


Figure 3.1 Philosophical notions of case study strategy and theoretical underpinnings

First of all, the researcher starts seeking the state of the art KBI by reviewing existing

theories and concepts including the changing global business environment (Dunning J., 2000, Prahalad C.K. and Hamel G., 1994, D'Aveni R.A., 1994) and creating knowledge-based competitiveness (Porter M. E., 1990, Prahalad C.K. and Hamel G., 1990, Volberda H.W., 1998), new trend of innovation through new production of knowledge (Lindley R.M., 2002, Gibbons et al., 1994) as well as existing literature on innovation related studies such as cluster theories (Acs, 1996, Simmie, 2004, Porter, 2000), firm-based innovation process (Croombs R., 1996, Nooteboom, 1999, Harris L. and Coles A.M. K. and McLoughlin I.P., 1999) and knowledge networks (Akg et al., 2005, Lambooy, 2004, Antonelli, 1996, Owen-Smith and Powell, 2004, Nerkar and Paruchuri, 2005). It is noted that whilst industry has been the key player of creating KBI, recent theories have stressed the importance of wide array of other public and private institutions in creating collective knowledge through Triple Helix relations of university-government-industry (Etzkowitz H. and Leydesdorff L., 2001, Etzkowitz H. and Leydesdorff L., 1997, Etzkowitz and Wolff, 2000, Etzkowitz and De Mello, 2003, Etzkowitz, 2004, Cooke P., 1998, Baber, 2001, Fujigaki and Leydesdorff, 2000, Giesecke, 2000, Jensen and Trgrdh, 2004, Leydesdorff, 2000, Leydesdorff L., 2001, MacArthur, 2000, Marques et al., 2006, Saad, 2004, Saad and Zawdie, 2005, Shinn, 2002, Webster and Etzkowitz, 2000). In other words, both the process and the agents of innovation are understood in much broader sense than hitherto. The analysis of these theories reveals the research gaps between theory and practice and the critical issues identified need to be further investigated in the specific context of KBI.

After the initial examination of the literature, region was identified as a location of knowledge-based innovation playing a key role in providing the institutional context and local environment for knowledge creation. A more detailed discussion on the regional innovation system has been conducted in section 1.3. The fundamental concern for both economists and innovation theorists is why knowledge-based innovation takes place in certain region and how less developed region can learn from the advanced regions. Whilst various literature suggests the importance of geographical configuration of KBI (Asheim and Isaksen, 1997, Patel and Pavitt, 1991, Asheim and Gertler, 2005, Cobbenhagen and Severijns, 1999, Cooke, 1992, Cooke, 1998a, Cooke, 2005, Heidenreich M., 1998, Nauwelaers, 1999, Simmie J., 2003,

TÅdtling and Trippel, 2005, Todtling and Kaufman, 2001, Wiig and Wood, 1997), it has been identified that the process of implementing KBI within the region needs to be further explored and examined, in particular the social and organizational process and the dynamic interactions within the process of creating KBI need to be addressed. (Lorenz, 1995)The focus of region as the context of research will provide opportunities to further explore the application of new theories and concepts and reveal the essential features of implementing KBI.

The micro level and implementation aspect of KBI was brought into attention within the current research due to the social and organizational dynamics of KBI and the network characters of the new model of innovation through Triple Helix relations of university-government-industry. The focus on the micro level of analysis helps to unfold the dynamics of knowledge creation and allow meanings arising from the issues identified in the new innovation paradigm. As a result, learning generated from the research on the micro-process can be feedback and linked to policy level and inform new theory and policy related to knowledge-based innovation.

Since the current research is to explore the process of creating knowledge-based regional innovation at regional level. The contextual elements such as institutional and historical and cultural context play an important role in understanding the process of knowledge-based innovation. The case study strategy is particularly appropriate for 'sticky' practice-based problems where the experiences of the actors are important and the context of action is critical (Benbasat et.al 1987).The process nature of the current study favors the adoption of case study which enables the exploration of the detailed operational activities related to knowledge-creation and interactions between key players. In addition, given the dynamic nature of knowledge-based innovation and there is no single template which explains the success of 'advanced regions'(Morgan and Nauwelaers, 1999), case study will help to capture emerging patterns or new practices that is implemented in reality which may induce new theory and inform new policy for innovation.

The nature of the research focus decides that a wide range of qualitative data need to be collected including the activities conducted by a wide range of actors during innovation process, the diverse interests of different innovation actors and context of innovation. In addition, empirical issues related to the social aspects of innovation such as personal interactions, values, beliefs and behaviour can only be better understood through qualitative analysis.

The practical reasons for adopting case study strategy over other research strategies such as survey or experiments lie in the constraints of these options that are unable to reflect and support the purpose of current research.

For instance, survey research, which is usually exploratory in nature rather than explanatory, is quite limited for the nature of the research topic which is focused on 'how' knowledge-based innovation is implemented and how the interactive process between key innovation actors are translated into practice through effective networking. What's more, survey research is conventionally conducted at a single juncture in time with a view to collecting systematically a body of quantifiable data in respect of a number of variables which are then examined to discern patterns of association (Bryman A., 1989). Survey method would not be suitable in the research context as the research tent to address 'process' of behaviour and organizing activities. These require an understanding of the dynamic nature of tasks performed and complexity of the network organizing process taking place. The survey method would prevent researcher exploring the full richness and variety of issues involved in the networking process. It is argued that undertaking research from process perspective must be studied over time. Researchers must closely and systematically observe behaviours as they unfold and the analysis must be based on details of the cases rather than the analysis of large samples (Fountain J., 2001). Similarly, experimental research appeal derives from the facility with which claims about causality can be established through experimental designs. The ability to impute cause-and-effect relationship is very much based on the much quantitative data collected (Bryman A., 1989). It would not be deemed as practical for current research which predominantly concentrates on investigating the interactive process within the regional innovation context. The nature of research is such that contextual factors are so important that may impact the way networks are constructed and implemented and facilitating the interactive process through networking requires studying over time

rather than on a one-off basis. In addition, the importance of contextual factors implies that it is extremely unlikely to find two regions that exactly replicate each other in terms of implementing knowledge-based innovation. Although different regions may adopt knowledge-based strategy for economic development, it is improbable that the implementation will be conducted in exactly the same way.

To summarize, case study has been argued as the most suitable research strategy for the current project. Yin (1989) points out that a research design should not only indicate what data are to be collected according to the nature of the research questions, but also include the design of case, unit of analysis and how data should be collected and analyzed. These issues will be discussed in the following sections.

### **3.2.2 Case Study Design**

Case study, like research of all kinds, has conceptual structure, i.e the choice of single or multiple case studies are organized around the research problems and key issues (Stake R.E., 2000). The current research project is focused on the analysis of the practice of knowledge-based innovation at a regional level. The process of investigation involves complex issues related to the social and economic regional context, nature and relationships between key innovation actors, which need to be properly understood in order to implement a successful knowledge-based economy. Despite of the well formulated theory in creating the knowledge-based innovation, the theoretical frameworks are yet to be tested in practice from implementation perspective. Thus focus on a single case based on the selected region will help to build up a rich insight and dynamic process of creating knowledge-based economy at a regional level. The processes identified during the implementation of knowledge-based innovation may inform learning and practices of other regions seeking the development of knowledge-based innovation.

It should be noted that within the single case study, two stages of research were conducted: the pilot study and main study.

#### **Pilot Study**

Pilot study is in general regarded as more relevant to positivist methodological approach rather than qualitative research strategy. (Sampson H., 2004) argues that pilot work is invaluable in conducting ethnographic as well as other forms of

qualitative research. When employing case study as research strategy, Yin (1989) suggests that a pilot case helps researchers to refine the data collection plans with respect to both the content of the data and the processes to be followed. Sampson (2004) further points out that while pilot study is often utilized in an informal way and is on occasion utilized by default rather than design, very few examples can be found of researchers reporting the systematic use of pilots in qualitative and ethnographic work.

Qualitative researchers are traditionally criticisms of subjectivity in their work. However it is suggested that by using multiple sources of evidence, establishing a chain of evidence and having a draft case study report reviewed by key informants, the effect of subjectivity can be counteracted (Yin R.K., 1994). Conducting pilot study is therefore one of the important processes for establishing a chain of evidence to present validity of the accounts because there are potential benefits in putting a toe or two in the research waters before diving in by conducting a pilot study (Sampson H., 2004). For instance, pilot study has been used to refine and develop research instruments (Gillham B., 2000), frame questions (Ball S., 1993), or collect background information and adapt research approach (Fuller M., 1993). In addition, the provisional findings can be tested out in the main study by comparing all the data fragments that arise in the case study (Glaser B. and Strauss A., 1967).

In sum, pilot study was regarded as essential before large amount of time are invested in the research project and minimize resource wastage (Sampson H., 2004), it would also help to develop relevant line of questions and refine conceptual framework of research (Yin R.K., 1989).

A pilot study was designed and incorporated the case study strategy in the current research to allow the researcher to:

- Test the assumptions prescribed in the theoretical framework and the key issues of concerns related to knowledge-based innovation;
- Refine and further develop appropriate research questions during main study
- Establish point of contact and build up relationships with informants within target organizations for main study
- Solidify support with participants and establish effective communication



pattern.

### **Main Study**

The main study in the current research is a further development of the research inquiry based on the results of the pilot study. It should be noted that the pilot and main study were closely linked together as part of the process of creating knowledge-based innovation. However, the pilot study has helped to develop a general understanding on the nature of regional innovation networking whereas the main study focus on the process of creating knowledge-based innovation within the region.

The selection of case in this study considered both purposeful and theoretical sampling strategies suggested by Siverman (2000). Many qualitative researchers employ purposive and not random sampling methods and seek out groups, settings and individuals where the processes being studied are most likely to occur (Denzin and Lincoln, 1994). In addition, sampling in qualitative research is neither statistical nor purely personal. It is or should be theoretically grounded (Stake, 1994; Bryman, 1988). As Mason (1996) argues that theoretical sampling is concerned with constructing a sample which is meaningful theoretically because it builds in certain characteristics or criteria which help to develop and test the theory and explanation.

The research problems identified in Chapter 1 and 2 and the theoretical underpinnings set out in section 3.2.2 entailed a single case study based in the North East of England. The selected case is not only a theoretically guided choice but also reflects the particular settings to be studied in line with the research purpose.

One of the key research issues generated from literature review is how knowledge-based innovation model developed from the advanced region can be applied in less developed region. The North East of England was chosen as the case study lies in the fact that North East has been traditionally perceived as a less-developed region (Marshall J. and Richardson R. and Hopkin J., 1999, Hassink, 2003), the particular regional settings of North East of England would provide a platform to examine the features of knowledge-based innovation outside the advanced regions. In addition, the regional government in the North East of England had been seeking various knowledge-based innovation strategies to generate innovation capacities and economic growth within the region. Selecting the case based on this region would

allow the researcher to explore the research gaps identified from knowledge-based innovation theories.

Given that activities related to knowledge-based innovation at a regional level are so vast that it would be unrealistic to investigate every part of the innovation activities in details. In fact, in an ideal world, the whole knowledge creation related initiatives or programmes would have been studied, i.e. every aspect of economic generation or innovation development activities in the region. However the most practical approach was to examine a particular process of knowledge-based innovation activities in relation to the overall knowledge economy in the region. Therefore, one of the key regional innovation programmes - Strategy for Success, was chosen as the main study of the research project.

In order to understand the nature of regional innovation networks, a pilot study was conducted by through the investigation of the regional inward investment networks, which is one part of the Strategy for Success innovation programme. Study on the process of inward investment networking would also help to gain strategic insight of content and processes of innovation activities within the region in terms of communication and information flow as well as the relationships between key innovation actors within the region. The relationships between the pilot and main study is demonstrated in figure 3.2 and the research focuses of the case study are summarized in table 3.1

**Creating Knowledge-based Innovation  
in the North East of England**

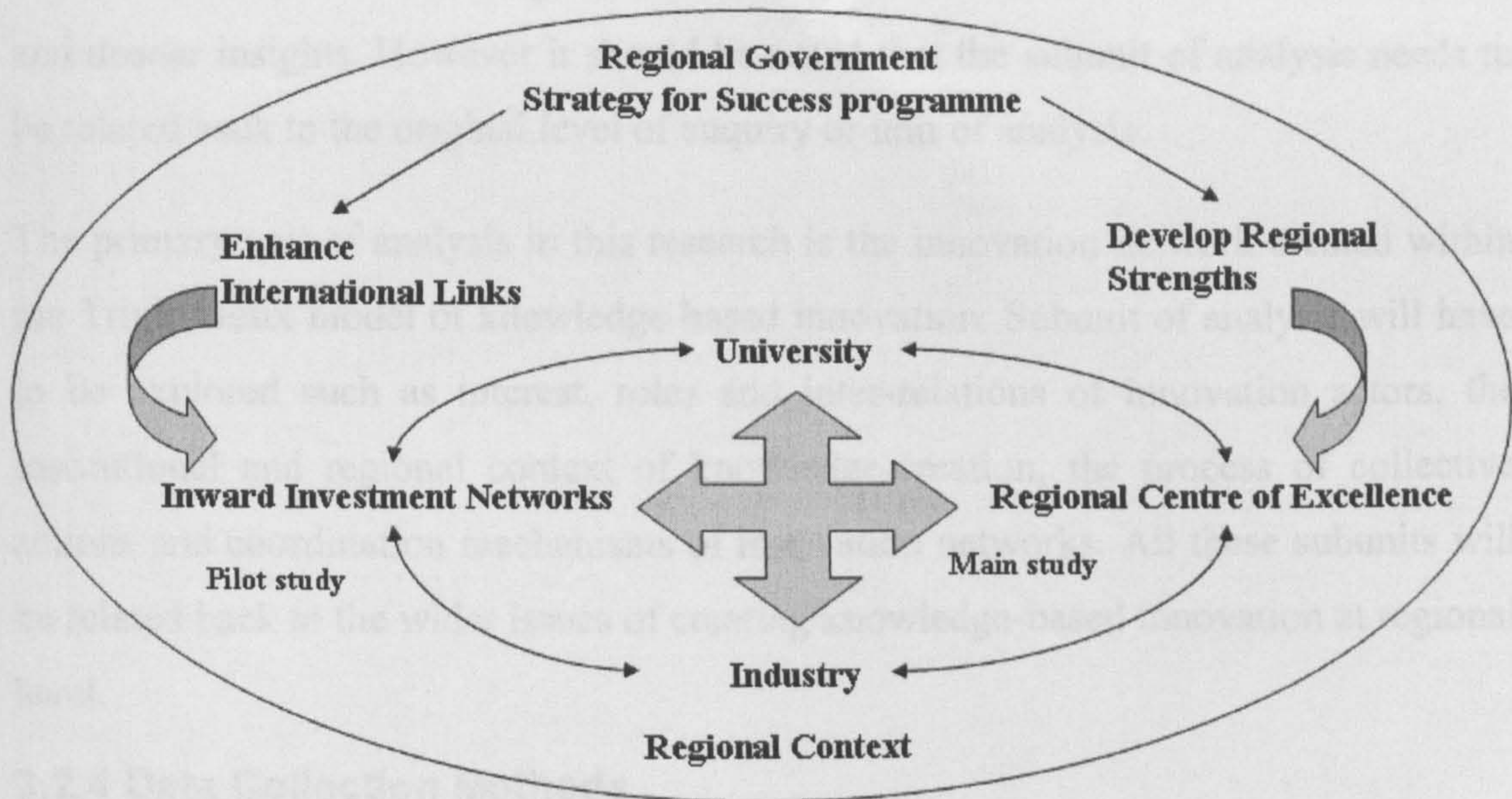


Figure 3.2 A Demonstration of Case Study Design

Case Study	Empirical focus	Theoretical Focus
North East of England	Strategy for Success Programme	Process of creating knowledge-based innovation
Pilot study	Inward Investment Networks	The nature and process of regional innovation networking
Main study	Regional Centre of Excellences and its Innovation Networks	The process of implementing Triple Helix relations of university-government-industry for developing knowledge-based innovation.

Table 3.1 The case study design and research focus

### 3.2.3 Unit of Analysis

The unit of analysis is related to the way the initial research questions defined (Yin R.K., 1989). It is drawn from the identified research questions and maintains the parameters of the research. The case may be an individual, an organization, a role, an industry, a community, a group, a project, a process or an event etc. The unit of analysis is drawn from the identified research issues and it also maintains the parameters of the research. What's more, it does not need to only be a single unit of analysis (Gillham B., 2000). In fact, as Yin (1994) points out cases may have subcases 'embedded' within them and there can be more than one unit of analysis. Within a case study strategy, subunits of analysis can be incorporated so that a more complex

or embedded design is developed (Stake, 1995, Yin R.K., 2003). Therefore the subunit of analysis can add significant value to the research and offer more extensive and deeper insights. However it should be noted that the subunit of analysis needs to be related back to the original level of enquiry or unit of analysis.

The primary unit of analysis in this research is the innovation network created within the Triple Helix model of knowledge-based innovation. Subunit of analysis will have to be explored such as interest, roles and inter-relations of innovation actors, the institutional and regional context of knowledge-creation, the process of collective actions and coordination mechanisms of innovation networks. All these subunits will be related back to the wider issues of creating knowledge-based innovation at regional level.

### **3.2.4 Data Collection Methods**

The evidence for case studies may come from six sources: documents; archival records, interviews, direct observations, participant-observation and physical artefacts. In addition to the attention given to these individual sources, some overriding principles are important to any data collection effort in doing case studies (Yin R.K., 1994). Sources of data can also be divided into primary and secondary data where primary data can be collected through methods such as interviews or questionnaires and observations, and secondary data can be gained from organizational documents, newspaper, journal articles etc. (Blaxter L. Huges C. and Tight Malcolm, 2002). The triangulation made possible by using multiple data collection methods provides stronger substantiation of constructs and hypothesis (Eisenhardt, 1989). It should also be noted that case study can combine both qualitative and quantitative evidence as well as use them as a stand-alone data collection method.

**Data source:** The data source collected for this research will include policy documents, corporate website, strategy documents, website, newsletters, journals / articles, organizational charts, internal memos, presentation materials, publications about the cases as well as semi-structured interviews, direct or indirect observations, informal conversations, field notes and e-mail correspondence.

**Semi-structured interviews:** Semi-structured and open-ended type of interview is widely adopted to enable interviewees to expand on what they consider to be

important and to frame those issues in their terms (Meredith et al., 1989). Producing interview guide is proposed as an important strategy for doing semi-structured interview (King N., 1994). Such interviews will allow researchers to probe deeply, to solicit expansive responses and thereby uncover previously hidden details and open up new lines of enquiry (Burgess R.G., 1982). The interview guide usually combines the theoretical framework developed from the research literature with interviewer's own experiences and personal knowledge (King N., 1994, Barnes D., 2001, Miles M.B. and Huberman A.M., 1994). It will help the researcher to focus on the research issues and bring chaos into order. The semi-structured interviews will potentially be conducted with top management (strategic), middle management (tactical), operational management (operational). It would be advantageous to interview any partners and knowledge users (clients).

**Tape Recorder:** Another common question regarding conducting interview has to do with the use of tape recorder. Although whether or not recording interview is in part a matter of personal preferences. It is argued the tapes certainly provide a more accurate rendition of any interview than any other methods. However a tape recorder should not be used when (1) an interviewee refuses permission or appears uncomfortable in its presence, (2) there is no specific plan for transcribing or systematically listening to the contents of the tapes (3) researcher is clumsy with the recorder that it creates distraction during the interview (Kvale S.) the researcher think that the tape recorder is a substitute for 'listening' throughout the course of an interview (Yin R.K., 1994). In addition to the above reasons, other situation may also prevent the researcher from using a tape recorder. For instance, the interview environment may be in public place and not suitable for recording due to the noises. Tape recorder is expected to be used during the interview in order to have more accurate information on the content of the interview. However, in the circumstance where an interviewee feels uncomfortable about the conversation being recorded, the researcher will not use the recorder.

**Filed notes:** whilst tape-recorded interview can produce what is said, field notes can help to enrich the data by producing the settings and context in which it was said. As it is suggested by Silverman (2000), that where you do not have access to naturally occurring data – such as tape-recordings, texts or documents – you must attempt to transcribe as much as possible of what is said and done, and the settings in which it is

said and done. In this sense, keeping research diary and field notes help to provide the contextual background which influences the behaviour and opinion of interview participants. Therefore field notes will be kept in order to make deeper and more general sense of what is happening in the field.

**Identify and maintain Contact:** Using contacts in industry, academia and friendship circles can be helpful in establishing what organization you might draw the case study from (Hartley J.F., 1994). The access to the case study will be initially through a personal contact. Based on the preliminary discussion with the initial contact, it is anticipated that other contacts and meetings can be established to allow accessing to relevant information and conducting interviews. It should be noted that gaining access is one thing, maintaining it requires continual attention (Hartley J.F., 1994). Therefore, during the process of research, regular contact and discussion with key informants will be carried out in order to maintain the research relationships. One of the useful tools suggested by Miles and Huberman (1984) is to develop 'contact summary sheets' to guide planning for the next contact, suggest new or revised codes and serve as the basis for data analysis.

**Snowball approach:** The snow ball approach has been adopted by a number of researchers when researching complex innovation systems or projects that involves relational and interdependent actors (Alderman et al, 2001; Benneworth, 2001). The snow ball approach means to start with a small number of managers or teams involved in the innovation networks for interviews to develop an initial understanding on the general nature of the content of innovation networks, then to snowball the research outwards to over other related innovation actors and network participants in the wider scales to build up a fair picture of the activities and a variety of opinions of actors from different institutional context.

It has to be acknowledged that the above techniques and research methods have been adopted which have been helpful and valuable to the current research project.

### **3.2.5 Validity and Generalization**

#### **Validity of Data**

Qualitative researchers with their in-depth access to single cases, have to overcome a special temptation. How do they convince themselves (and their audience) that their findings are genuinely based on critical investigation of all their data and do not depend on a few well-chosen 'examples' is the key issue that need to be solved for qualitative researchers taking interpretive approach (Yin R.K., 1981, Eisenhardt, 1989, Gillham B., 2000, Bryman A., 1988, Hartley J.F., 1994). This is known as the problem of 'anecdotalism' (Silverman, 1993). In addition, case study is viewed sceptically by researchers who consider it lacking in rigor and objectivity and whether the measure used in the research will produce the same results when applied to the same subjects by different researchers. It is suggested that measures have to be taken to ensure the robustness and quality of the research strategy (Yin R.K., 1994).

Yin (2003) suggests tactics for dealing with four different aspects of validity: construct validity, internal validity, external validity, reliability. Construct validity can be ensured and cross-validation. Internal validity can be maintained by making sure that all rival explanations and possibilities are considered before making any inferences. Beliefs must be carefully articulated and every observation constantly questioned so as to avoid being blinded or misdirected by what the researcher brings to the study (Bryman A., 1988, Bresnen M., 1988, Fuller M., 1993)

The validity of overall research is through the design and conduct of pilot study and main study where the internal validity of the research is achieved through pilot study and the external validity is approved through further investigations during main study. There are a variety methods adopted within current research to ensure the validity of the data.

First of all, the validity of the data collected through pilot study and main study were managed through the process of data collection in terms of what and how data should be collected in relation to the focus of the research inquiry. Secondly, to manage the reliability of interview, an interview schedule was prepared and tested to a couple of participants to ensure the content of the questions are understood. Thirdly, the interviewees were carefully selected from the organizations that were involved in innovation networks with different functions and at various levels of management. The profile of individual interviewees was arranged from top business executives

within companies, managers and officials from government agencies, and academic researchers from universities. It was hoped that through such arrangement every observations and opinion on the process of knowledge creation could be obtained and the researcher would be able to develop a full picture of the operational practice of knowledge-based innovation.

In addition, transcribes of interviews were sent to every interviewees for feedback to ensure that there were no misunderstandings during the interview process. Feedback to the participant organization was conducted through providing a hard copy of the report which is abstracted from the academic thesis, and also the presentation to the participant organizations. The pilot study report was provided to the senior manager in the inward investment team for comments and validity of the researchers understanding and interpretation of the data collected. The main study findings were presented in the academic seminar in which representatives from participant organizations were present to provide feedback and clarify misunderstanding on the key concerns. Cross-validation was also used by asking different interviewees the same issue or direct/indirect observations to make sure the information collect reflect the reality.

What's more, it is argued that the interpretation of qualitative research should not appeal to single element as an explanation (Silverman, 2000). Thus, the presentation of the data would draw from the opinions of a wide arrange of the participants to make sure the interpretation of the data reflects truth. The discussions and analysis of the data was also combined with research diaries and filed notes which contained the observations on the filed.

In order to sustain external validity, a pilot study was undertaken to test the theories before carrying out main study. Finally, the reliability must be maximized by making sure biases are eliminated from the research. Once conclusions were drawn the results were verified through feedback from participants.

### **Analytical Generalizations**

The question of generalization also remains the central debates of undertaking qualitative, in particular case study research strategies. The more common recognized



way of generalizing is 'statistical generalization' where an inference is made about a population (universe) on the basis of empirical data collected about a sample. However it is argued that a fatal flaw in doing case studies is to conceive of statistical generalization as the method of generalizing the results of the case. This is because cases are not 'sampling units', rather they are theoretically guided choice (Silverman, 2000).

Under these circumstances, the method of generalization for qualitative case study is through 'analytical generalization', in which a previously developed theory is used as a template with which to compare the empirical results of the case study (Yin R.K., 1994). The theoretical orientation of qualitative case study can provide a close-up, detailed view of particular units which may constitute cases which are relevant to or appear within the wider universe (Mason, 1996). The generalization of case study lies in the theoretical propositions and what can be learned from the case, rather than populations. Thus the processes and issues identified from a single case study based in the North East of England in creating knowledge-based innovation would inform other regions that adopt knowledge-based innovation strategies.

### **3.2.6 Summary**

Section 3.3 introduced the main research strategy adopted in line with the overall research design. A detailed account on the case study strategy was provided and explained including unit of analysis, data collection methods and the rationale of selecting the current case. North East of England was selected as the case for investigating the implementation of knowledge-based innovation. Semi-structured interview was used as the primary data collection method although a plethora of other methods were also adopted. The validity the case study was achieved through both internal and external methods including the design of different stages of research and the ensuring the reliability of data collected. It was pointed out that the generalization of current study lies in its theoretical and practical contribution for understanding the key issues emerged from the process of implementing knowledge-based innovation rather than statistical generalization.

The remainder of this the chapter will describe the implementation process of research strategy and how the core elements within the case study were appropriately managed

and how research findings were presented and analyzed.

### **3.3 Implementing Case Study**

#### **3.3.1 Outline of Research Process**

The main research activities in accordance with the research design and strategy are described in table 3.3.

It should be noted that although literature provides the basis for generating research interests and helps the understanding of the main theories underpinning the research design and strategy, it would be wrong to assume the actual case study could be undertaken without further review of the relevant literature. Therefore the literature review indicated in step 1 is merely an indication of its importance as a starting point. Continuous reviewing and updating relevant theories will be carried out throughout the research process till the completion of the research project.

Research Timescale	Research Strategy	Research objectives	Research Activities conducted	Data Collection Methods / Source of information
Step 1 Jan 2001- June 2006	Literature Review	Understanding knowledge-based innovation theories.	<ul style="list-style-type: none"> <li>• Reading</li> <li>• Keeping research diaries</li> <li>• Exchange ideas with supervisors and other researchers.</li> </ul>	<ul style="list-style-type: none"> <li>• Academic journals, books</li> <li>• Government white papers &amp; reports</li> <li>• Public website</li> <li>• Regional Business Review/ Newsletters</li> </ul>
Step 2 Sept 2001 – Sept 2002	Pilot Study	Nature and process of regional innovation networking	<ul style="list-style-type: none"> <li>• Establishing initial contact</li> <li>• Identify test research questions</li> <li>• Carrying out field work</li> </ul>	<ul style="list-style-type: none"> <li>• Semi-structured interview</li> <li>• Field notes</li> <li>• Interview transcripts</li> </ul>
Sept – Dec 2002		Preparing for main study	<ul style="list-style-type: none"> <li>• Refine research questions</li> <li>• Design main study</li> <li>• Keep updated theories</li> </ul>	
Step 3 Jan 2003- Aug 2005	Main study	Process of implementing Triple Helix model of knowledge-based innovation.	<ul style="list-style-type: none"> <li>• Review innovation policies</li> <li>• Conduct interviews</li> <li>• Analyze research findings</li> <li>• Feedback to clients</li> <li>• Validate data</li> <li>• Draw conclusion and make recommendations</li> </ul>	<ul style="list-style-type: none"> <li>• Semi-structure interview (face-to-face or by telephone)</li> <li>• Site meeting</li> <li>• Direct / indirect observation</li> <li>• Field notes</li> <li>• Interview transcripts</li> <li>• Presentation, seminar / workshops</li> </ul>
Step 4 Sept 2005- June 2006	Writing up			
Keep in touch with participants for further research				

Table 3.2 An illustration of Research Process

### **3.3.2 Conducting Interviews**

#### **Interview Questions**

As established previously, a case study was believed to be the most effective strategy for this particular research project with semi-structured interviews being the main data collection methods but supplemented with direct and indirect observations and informal correspondence as well as a range of secondary data sources. Semi-structured interviews were conducted with senior executives (at strategic level involved in policy making), middle management (project managers and financial directors) and operational management (administrators, officers and junior business specialists) in the context of government agencies, business organizations and the business development functions within the university. In addition, academic researchers and spin off companies, business consultants and intermediate organizations were also involved during research process as part of the wider networks of knowledge creation in the region.

Depending on the role of interviewees and projects they involved in, some interview questions were more applicable than others. Therefore the interviews were tailored to suit individual interviewee. The nature of the semi-structured interview also allows opportunities for new issues emerging during the process of interviews.

In general, the research questions include organizational background which explores the background, history of the organization. This was undertaken first by doing background reading and searching on relevant documentation from government website, public brochures, seminar presentations and other accessible publications. It was essential to establish the institutional background and more importantly understand the context in which the knowledge based innovation policy was formulated and constructed as well as the role played by institutions involved in the policy networks. Then this information had been further explored during semi-structured interviews, in particular how the policy networks were interpreted by senior management teams.

In addition, it was also important to gain insights into the operational processes between the government managers (e.g. inward investment team during in pilot study) and new organizations created by government (e.g. the regional centre of excellences

in main study) and the working partners including university, industry and other business support organizations in the region. This had involved questions about their existing working procedures within and between organizations, the nature of the relationships with other innovation actors during networking process, communications conducted between teams, roles played by individual actors, and how managers work together to deliver innovation project and facilitate knowledge creation.

In terms of the process of generating innovation capacities, the questions relating to pilot study focused on how inward investment teams engage regional partners and develop international linkages to create innovation opportunities within the region. The semi-structured interviews with regional Centre of Excellences during main study concentrated on how the managers facilitate and support university-industry interaction and knowledge sharing between academics and regional firms. The opinions from industries were also taken into consideration through meetings and interviews with managers from private companies about their perceptions of the support from the regional government in developing firms' ability of innovation. What's more, since the primary concern of the research was to analyze the interactive process and evaluate whether networks were performed as intended. Evidence was sought on particular how information was shared between individuals working across institutional boundaries, what main activities involved in facilitating information sharing? How relationships were developed during the processes of interactions at different levels? What were key challenges facing innovation actors?

Finally, data also needs to draw the contextual and cultural setting of the case study. This would contribute to the development and advancement of theories. Some specific questions were raised to touch the context and cultural issues during interviews. However a better understanding of many of those issues was achieved through general observation, informal conversation and indirect interactions with people performing the networking tasks throughout the research process.

The case study attempted to meet the research objectives by posing specific questions during the interviews. The nature of the semi-structured questions was to lead interviewee into the area which researcher intends to explore in more details.

### **Profile and Roles of Interviewees**

One of an important strategies adopted in this research for ensuring the validity of the data as explained in section 3.3.4.2, is through careful selection of a wide range of innovation actors who are involved in different level of innovation networks so that the insights of implementing knowledge-based innovation can be obtained and understood. The selection of interviewees was informed by the key research issues concerned in this study and therefore mainly selected from three institutional context, university, government and industry.

However it should be noted that as the innovation networks are changing and evolving during the process of interactions. The functions and roles of managers are changing over time, therefore the 'Snow Ball' approach of collecting data discussed in 3.3.2.3 is also used to maintain a certain degree of flexibility and allow researcher to focus on emerging issues. Therefore through initial pilot study and the snow ball approach, the interviews were conducted with the innovation actors from the following categories: university researchers, university business development managers including technology transfer managers, executives and R&D managers from regional firms, business support managers from government agencies and entrepreneurs from spin-off companies involved in innovation networks. It is noted that during the process of research, it is difficult to draw a clear line of the different categories. For instance, some of the academic researchers start to establish their own business and become the principle agents of spin-offs during the process of conducting research. Managers from the government agency also involved in technology transfer projects as well as performing the facilitating role in knowledge creation. Notwithstanding this difficulty, the interviews conducted during pilot and main studies are enumerated as below:

Stage of research	Category of Interviewees	Status*	Numbers
Pilot Study	Regional government agencies	SM *	1
		OM	3
		JO	1
	Sub-regional partners	SM	3
		OM	4
	University academics		1
	Overseas firm	SM	3
	Regional firm	SM	1
Regional business support organizations	SM	1	
	OM	1	
University managers	SM	1	
	OM	1	
Main study	Regional Development Agency	SM	1
		OM	2
	Strategy for Success team	SM	2
	Science & Industry Council	SM	1
	CoE – Centre for Life Science	SM	2
		OM	2
	CoE – Nano Technology	SM	2
		OM	2
		JO	1
	CoE – Code Works	SM	1
		OM	3
		JO	1
	CoE – Renewable Energy	SM	1
		OM	1
		JO	1
	CoE – Process Industry	SM	1
OM		2	
City Council	SM	1	
	OM	1	
University spin-offs		3	
University researchers		4	
University Development Managers	SM	2	
	OM	3	
Other regional business support organizations	SM	1	
	OM	1	
Regional firms (five interviewees are from 5 different firms involved in relevant technological innovation in the region.)	SM	2	
	OM	3	
Total			68

\*SM - Senior Manager; OM - Operation Manager; JO - Junior officer/administrator  
Table 3.3 The Profile and Roles of Interviewees

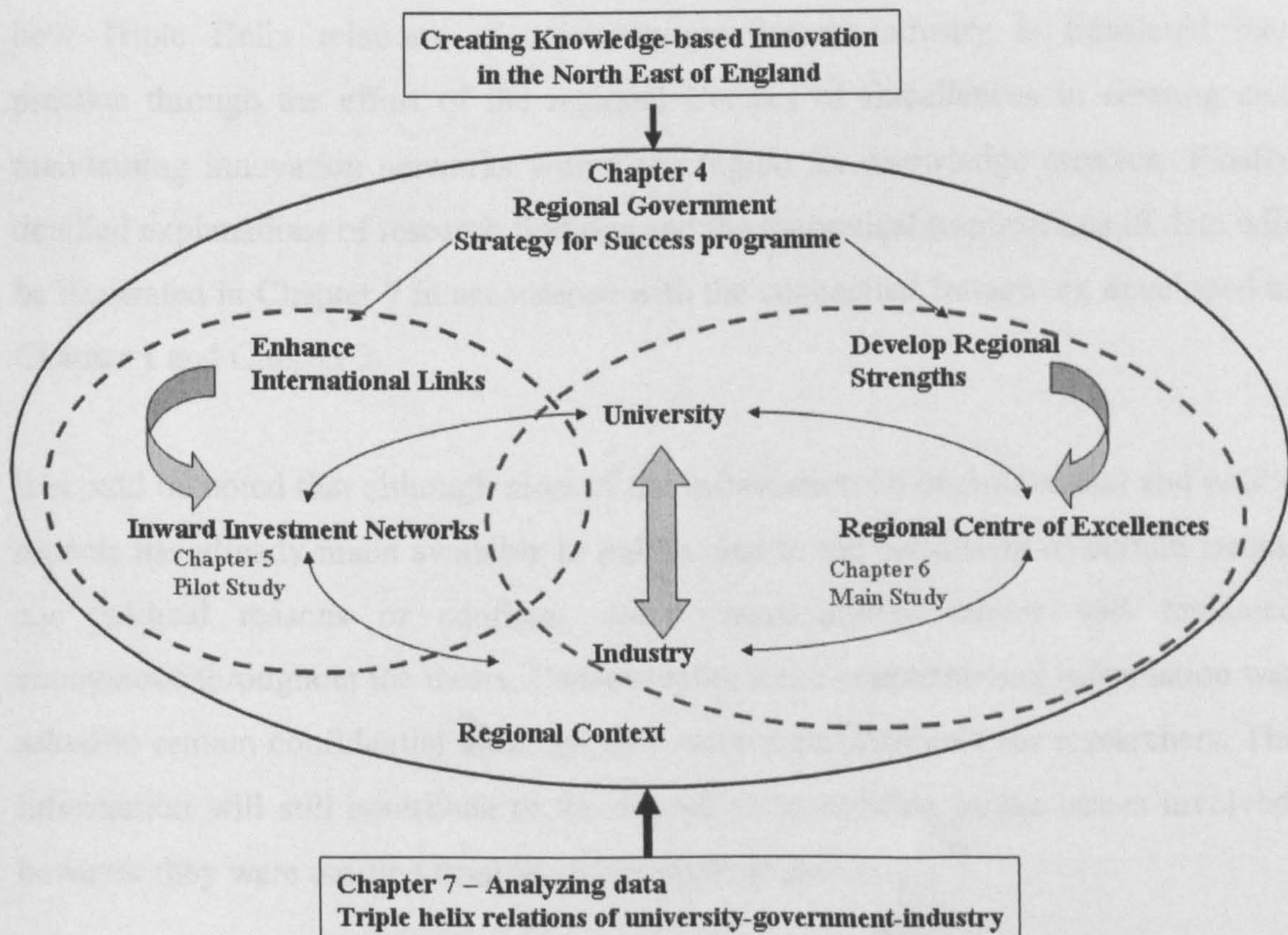
### 3.3.3 Presenting and Analysing Data

There are different forms of presenting case studies. (Miles M.B. and Huberman A.M., 1994) propose two key elements of presenting case study: description and explaining. Description in (Bernard, 1988)'s terms, means 'making complicated

things understandable by reducing them to their component parts'. This means making a clear accounting of the phenomena at hand. Explanation as Bernard suggests, denotes making complicated things understandable by showing how their component parts fit together according to some rules – that is, theory. Usually it is hard to explain something satisfactorily until you understand just what the something is, therefore it is important for researchers to combine description and explanation careful when presenting a case study (Miles M.B. and Huberman A.M., 1994). The way presenting case study in this research contains both description and explanation (through discussions) approach so that patterns, insight is generated and the complexity and variety of the case can be analyzed and understood.

### Presenting Case Study

The empirical findings from the research project and key issues identified will be presented and analyzed in Chapter 4 to 7. Figure 3.3 illustrates the process of presenting the case.



The overall background of the case and the policy context will be introduced in



Chapter 4. This will help to understand the historical and institutional context of the region and identify the institutional relationships and networks emerged from the initiation of the knowledge-based innovation strategy. In addition, description of policy networks will also provide a strategic framework which denotes intended communication and information flow within the innovation networks.

As part of research design, the pilot study plays an important role in generating initial understanding on the nature and process of regional innovation networking. The substantive findings from pilot study will be presented in Chapter 5, which is based on the analysis of one of the important innovation activities related to developing regional knowledge economy— inward investment networks. In Chapter 5, how managers from regional development agency engage with a wide range of regional actors as well as sub-regional partners to attract inward investment will be explored and the process of creating and maintaining innovation networks between regional partners will be investigated. The findings from main study will be described in Chapter 6. Based on the investigation of the implementation of Strategy for Success programme in the North East of England, the main study is focused on the analysis of how Triple Helix relations of university-government-industry is translated into practice through the effort of the regional Centres of Excellences in creating and maintaining innovation networks within the region for knowledge creation. Finally detailed explanations of research findings and the theoretical implications of data will be illustrated in Chapter 7 in accordance with the conceptual framework developed in Chapter 1 and Chapter 2.

It should be noted that although most of the information on organizational and policy aspects has already made available to public, due to the sensitivity of certain issues, e.g. political reasons or conflicts, some organizational names will remain anonymous throughout the thesis. Consequently, some organizational information was asked to remain confidential although they were made available for researchers. The information will still contribute to the overall understanding of the issues involved, however they were omitted from the description of the case.

### **How to Explain Data**

The question of why things happen is at the forefront of the research experience, once

you are past the basic problem of understanding just what is happening. There is no single set of rules for the analysis of data from qualitative research interviews (King N., 1994). To explain why things happen, (Draper, 1988) points out that 'explaining' can include a range of activities: proving requested information or descriptions, justifying an action or belief, giving reasons, supporting a claim, or making a causal statement. However, it is argued that scientific explanation of human behaviour is an even narrower sub-band (Miles M.B. and Huberman A.M., 1994). For (Kaplan, 1964), explanation is a 'concatenated description.....putting one fact or law into relation with others'.

It is further argued that the interpretation of data involves the transcendence of 'factual' data and cautious analysis of what is to be made of them (Coffey and Atkinson, 1996). The key difference between qualitative and quantitative data is that the former is made of worlds rather than numbers. The key issue, then is how to move these words to data analysis. There are four concurrent flows of activities that have been suggested for explaining qualitative data: data reduction, data display, conclusion and verification. (Miles and Huberman, 1984).

- *Data reduction* refers to 'the process of selecting, focusing, simplifying, abstracting and transforming ....raw data'. It involves making decisions on which data trunks will provide the initial focus.
- *Data display* is 'an organized assembly of information that permits conclusion drawing and action taking'. It involves assembling the data into displays which clarify the main direction of the analysis.
- *Conclusion drawing* means 'beginning to decide what things mean, noting regularities, patterns, explanations, possible configurations, causal flows and propositions'.
- *Verification* means testing the provisional conclusions for their plausibility, the sturdiness, and the validity.

A striking feature of research that builds theory from case studies is the frequent overlap of data analysis with data collection (Glaser B. and Strauss A., 1967). It is only by undertaking cycles of data analysis that a satisfactory rational interpretation can be reached. If the case study is to build up a theory, with (Rein and Schon, 1977), that theory is a sort of map seeks to generalize the story at hand. A more worked out theory might be called 'a model'. To put it in another way, a theory can be seen as a

predicted pattern of events (Yin R.K., 1981). However (Van Maanen, 1979) argue that there aren't really two compartments – 'theory' and 'data'. Rather there are first – order concepts – the so called 'facts' of a qualitative study, which never 'speak for themselves' and second-order concepts – 'the notions used by the researcher to explain the patterning of the first –order concepts.' Therefore the facts are actually the events to which we have given meaning and they are already the product of many levels of interpretation.

During the process of research, ongoing data analysis was undertaken to try and achieve a satisfactory level of understanding of the case. The process of analyzing case study in this research follows the concurrent activities of data reduction, data display, conclusion and verification. In addition, research diaries and field notes will be kept to show how the theoretically defined elements are assembled and linked. Data collected during pilot study will also be developed to build up an initial conception of the setting and perspectives of the innovation actors. The understanding will be tested, modified and developed through additional cycles of data collection during main study and analysis until an adequately coherent interpretation is reached. In this research project, overlapping data collection and analysis allow researcher to take advantage of flexible data collection. As (Eisenhardt, 1989) indicates that a key feature of theory-building case research is the freedom to make adjustments during the data collection process to probe emerging themes.

### **Principles of Analysis**

Given the underlying research philosophy is from interpretive approach, a number of suggestions are made by (Klien and Maxwell, 1994) when undertaking data analysis. It is suggested that the researcher should consider the whole phenomena and reach an understanding by investigating the individual part of the phenomena under investigation. Silverman (2000) points out that it is important that researcher focus on the processes through which the relationships of each key element is articulated. By gaining an understanding of the individual parts and their interrelationships, the researcher is then able to improve the understanding of the whole context and in turn further improve their understanding of the parts.

In addition, it is pointed out that the researcher also needs to critically reflect on the

context of research including social, political, economical and historical background so that intended audience can gain a better understanding of how the current situation is investigated. It should be noted that due to the nature of the research that is focused on the implementation of knowledge-based innovation in a regional context, it would be difficult to analyze innovation networks without a fully understanding on the historical context of the region and the policy context which is associated with various institutions and business organizations. Therefore it is unavoidable that some business organizations related to the implementation of the knowledge-based innovation will be mentioned for the purpose of academic discussions and analysis of theoretical implications although all the interviewees will remain anonymous and confidential during the process of presenting and analyzing data.

What's more, it is argued that researcher should seek out study the phenomena from different perspectives so as to gain the whole picture, and also should be sensitive to possible 'biases' and 'distortions' in the narratives collected from participants (Klien and Maxwell, 1994). In order to avoid biases from individual interviewee, the presentation and discussion of case study are drawn from both direct observations, field notes as well as the opinions of actors working at different levels within the organizations e.g. senior, operational managers and junior officers within the organizations in order to make sure a wider representation of the issues of concerns regarding the effective implementation of knowledge-based innovation. Another common criticism of qualitative research is that the validity of data is undermined by unclear attribution of the sources of verbatim quotes used during the presentation of the case. This was managed by clearly indicating the profile of interviewees who are from different part of the innovation networks with different roles and organizational context so that the issues raised and conclusions were not based on a small set of sample of the data.

All these principles discussed above guided the collection and analysis of the data during this research as Klein and Maxwell (1994) are not suggesting that researcher should sequentially apply all principles during research. What they are suggesting is that these principles need be judged by researchers themselves under discretion and apply principles that are relevant to their research.

## **Developing Themes and Patterns**

The search for meaning is often a search for patterns (Stake, 1995), which is suggested by Eisenhardt (1989) that is to select categories or dimensions and the look for within-group similarities coupled with inter-group differences. Dimensions can be suggested by the research problem or literature. Another tactic is to divide the data by data source. For example during the research, information collected from interview can be compared with the evidence from direct observation or documentation search. If the evidence conflicts, the researcher can further investigate on the issue to identify the reason of differences.

As the data collection is completed, the researcher will first of all make sense of the corpus of the raw data. During discussions and analysis of the raw data, extracts of data, experiences and viewpoints that are collected from the field will be unfolded. Data will be bound together to demonstrate and connect between key patterns and themes and to manifest the theoretical focuses of the research. The patterns and areas of focus are manipulated and divided under different thematic headings, which will then become section or chapters.

### **3.3.4 Summary**

Section 3.4 dealt with the process of implementing the case study strategy. It starts by outlining the overall research process and academic activities involved in three main stages of research, i.e. conducting literature review, carrying out pilot study and undertaking main study. The process of interviews was also introduced by giving detailed account on the design of interview questions and considerations on the profile and roles of interview participants. It was hoped that in this way all rival explanations of the research problems are covered from the data collected so that the results generated from the study would not be blinded or misdirected by what researcher brings about to the field. Once empirical data had been collected, the next important stage was to present and analyze research findings. The process of presenting the current study was illustrated and the principles of data analysis and methods used to ensure the validity of data were discussed.

## **3.4 Limitations of Research**

Based on the nature of the research problem, case study has been adopted as the

appropriate research methodology in this study. A number of measures were taken to ensure the case study validity (Yin R.K., 1989). Every attempt has been made in order to make the research strategy as rigorous and robust as possible. The research involved interviewees across different functions and organizations from different levels to ensure the information collected reflect the whole situation. The case study also entailed as many different data collection techniques as possible including face to face or telephone based semi-structured interviews, government report, internal memo, seminar presentations, informal conversations during networking events, chance meetings and direct and indirect observations. Moreover, the interview transcripts were sent to interviewees and findings were presented to different participants to ensure there were no misinterpretations of the data.

However, the research conducted still had some limitations which should be highlighted. First and foremost, it would have been useful if the researcher had been able to interview all innovation networks related to CoEs in all the five technology areas. This would have provided a comparative view on the different strategies and operations within the centres. This was possible in a couple of centres. For instance, in studying the Centre for Digital Technology (Codeworks), the researcher was able to interview nearly all team members as well as the partners from university and industry. From the interviews with the partners of Codeworks, the researcher was able to gain full picture of the innovation networks and understand challenges from different aspects. It was also helpful to cross-checking issues that were raised by one party and might be interpreted differently by others. However due to practical reasons it was not possible to access to all centres innovation networks. One reason was that there are difficulties of accessing organizations and some CoEs do not want to pass contact to the researcher due to the confidentiality of information.

The second limitation was that customer contact via CoEs was companies that benefit from CoEs service and therefore were inclined to highlight the support of CoEs and there is lack of comments on the problems involved in networking. Therefore a slightly biased picture might have been possibly provided. Moreover, whilst the research outcome do give pointers on how innovation policy might be modified so as to yield maximum impact on knowledge creation, the researcher had been concentrating on the social and organizational process of implementing knowledge-based

innovation strategy, and less attention has been paid on the specific technology area and the potential impact on the way innovation networks were constructed and shaped by particular technology sector.

A final limitation was evident that as the research had been conducted in the context of North East of England. The generality of research finding is obviously constrained by the sample and the context. Even though grounded case study allow for theoretical generalization, the empirical generality remains an issue for further study (Yin R.K., 2003). The researcher has been able to speculate on how knowledge-based innovation strategy has been implemented in the North East region, similar studies in other regional context would help shed more light on understanding the process of knowledge creation and developing innovative regional knowledge economy.

Despite the limitation of the research strategy, the case study provides a range of rich and informative information with in-depth analysis, which have offered additional perspective to complement existing studies on knowledge-based innovation. It has also enabled the research in this field to be developed further and new ideas and issues to be taken forward.

### **3.5 Conclusion**

This Chapter provided an overview on the philosophical and methodological issues underpinning the current research design and implementation of empirical research.

The overall research design which is based on interpretive stance with qualitative analysis is driven by the nature of the inquiry and the research questions identified from the current state of knowledge related to innovation studies. Critical examining existing literature revealed in a number of research gaps that need to be addressed from both theoretical and methodological perspectives. The need for further study has orientated towards case study as the main strategy to examine the critical issues related to new patterns of innovation that leads to economic growth at regional level.

The design of the case study was described with detailed explanations on unit of analysis, data collection methods and the process of building up a cohort of compelling evidence through pilot and main studies in order to gain greater insights

for analysing knowledge-based innovation. The process of implementing the case study strategy was illustrated with a particular focus on how the process was carefully managed to ensure the reliability and validity of data through appropriate interview design, presentation of the case and principles of analysis. Finally, the limitation of current research was discussed.

Next Chapter will provide an overall background of the knowledge-based innovation strategy in the North East of England.



# Chapter 4: Background and Innovation Strategy in the North East of England

## 4.1 Introduction

This Chapter begins by outlining the context of knowledge economy and innovation in the UK which leads to the formulation of the government strategy of enhancing competitiveness through knowledge creation and innovation. Then the background of North East of England as one of the regions in the UK to implement the knowledge economy will be introduced and the core elements of the knowledge creation strategy – Strategy for Success programme, will be described and discussed.

## 4.2 Knowledge Economy and Innovation in the UK

There appears to be a consensus in policy and academic communities that knowledge becomes a form of capital and a globally competitive knowledge economy is a ‘zero option’ for the UK (Hepworth and Spencer, 2004). In UK DTI (Department of Trade and Industry/Department of Education and Employment) report “Competing in Global Economy - The Innovation Challenge” identified a number of key factors which determine the innovation performance in the UK. One of the important factors is the capacity to absorb and exploit knowledge, which defines a firm’s ability to turn knowledge into profitable goods and services and government should have a facilitating role in exploiting knowledge. In 1998, the UK government published the Competitiveness White Paper: *Our Competitive Future: Building the knowledge Driven Economy* (DTI, 1998), which lays out the foundation of the overall government policy to cope with the challenges of the global competitiveness and develop strategies to stimulate the knowledge economy through effective regional innovation in the UK.

### 4.2.1 The Government Competitiveness White Paper

The British Government’s approach to the knowledge economy is set out in a series of *Competitiveness White Papers* (1997-2001). The Competitiveness White Paper (DTI, 1998) defines the knowledge driven economy as “....one in which the generation and the exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; it is also

*about the more effective use and exploitation of all types of knowledge in all manner of economic activity.”*

In the Prime Minister's Introduction to the 1998 Competitiveness White Paper, Building the Knowledge Driven Economy, it was stated that "...we will only compete successfully in future if we create an economy that is genuinely knowledge driven. We know from experience that the best way – indeed, the only effective way – to respond to globalization is to build a strong, modern knowledge economy. Our success depends on how well we exploit our most valuable assets: our knowledge, skills, and creativity. These are the key to designing high-value goods and services and advanced business practices.”

Although it is widely acknowledged that creating the knowledge economy requires effective generating and exploiting new knowledge and innovative ideas, it is noted that the UK produces much excellent research but the record on production of new goods and services is nowhere near as good (DTI, <http://www.innovation.gov.uk/innovationreport> ). The main issues identified in the innovation report are regional innovation and knowledge transfer. The report concluded that more needed to be done to encourage business taking new technologies out of the science base and into the market. As a result a number of policies recommended for creating an innovative region, these include Regional Development Agencies producing regional economic strategies which reflect the knowledge economy and innovation agenda, the establishment of regional science and industry councils as regional advisory bodies that bring together science, technology and business representatives, and supporting investment in the region to enable RDA to attract high value-added businesses.

In addition, there is evidence that regional economic development is held back because universities are not well-linked to the local businesses, which reduces productivity and competitiveness growth. The white paper indicates that intention of government trying to strengthen the role of universities in driving the knowledge economy and developing specific resources and commitments for universities to activate the changes that Government wishes to make. There is intention to establish the top class innovation centers which has long-term research partnerships between

major business interests and the university sector. The innovation centres will create new dynamic links for economic growth and will be at the heart of cluster development and support for new start-ups and business that are growing in business incubators through them, businesses will be able to make the most of the specialist knowledge that is available regionally (DTI, 1998)

Competitiveness White Paper certainly outlines the strategic directions and policies for creating the knowledge economy, the DTI white paper in 2000 – ‘Excellence and Opportunity – A Science and Innovation Policy in the 21<sup>st</sup> Century’ further emphasize the importance of developing innovation capacities through science-based technology transfer and commercialization. In the white paper, the role of university as knowledge institution is addressed in promoting regional clusters and developing knowledge-based innovation (DTI, 2000). Following the encouragement from government in enhancing the role of university in the knowledge economy, Lambert (2003) reviewed relationships between universities and industries and identified a number of issues which are perceived as critical in promoting university-business collaboration for technology transfer and commercialization.

#### **4.2.2 University – Industry Collaboration - Lambert Review**

Driven by the knowledge economy strategy, Richard Lambert, who is a member of the Bank of England’s Monetary Policy Committee conducted The Lambert Review, which commissioned by HM Treasury, the Department for Education and Skills and the Department for Trade and Industry in November 2002.

In his report on innovation and university-industry relationship, Lambert (2003) indicates that two broad trends are reshaping the way that companies are undertaking research around the world. The first is that they are moving away from traditional R&D approach and carrying out regarding in this own laboratories and towards the way of collaboration and seeking new form of open innovation. The second trend is globalization. i.e. business R&D are going global. Businesses are seeking outstanding world class research centre, and their home countries are no longer the automatic first choice for their R&D investment.

The broad trends have certainly brought about big implications for university, which

are playing an increasingly important role in the regional economic development and regarded as the centre of the knowledge economy. Especially it is evident that universities in the UK have gone through dynamic changes and many universities have been trying to cast off their ivory tower image and play a much more active role in the regional and national economy. With international well-known academics and their international networks and world-class facilities and laboratories, universities become attractive research partners for industry. UK universities have a strong science base, and there is significant potential to transfer this knowledge to business in the form of Intellectual Property (IP). Most UK universities have developed technology transfer offices, and staff members rising rapidly. Increasingly, universities system will be the locus of fundamental discoveries. And industry will need to work with universities to transfer these discoveries into innovative products, commercialized through appropriate business models (Chesbrough, 2003). There is more to be done to encourage "business pull" - taking new technologies out of the science base and into the market. It was noted that a diverse knowledge economy can be developed through collaboration in four areas in the region (Lambert R., 2003):

- Working with and adding value to university resources and make access to knowledge easier to create value for local industry.
- Collaboration between regions to create National Centre and networks and generate and commercialize Intellectual Property Right.
- Commercialization of innovative product and services through enhance cluster development
- Collaboration with other regions to achieve critical mass in key technology areas.

Encouraging stronger links between business and universities is important if we are to be more successful in the commercial exploitation of technology. Firms are increasingly developing direct links with the academic science and engineering base, currently maintained by only a minority of high-technology businesses. At the same time, firms are making more use of qualified scientist and engineers in local higher education institutions as a source of expertise, participating in expert networks of graduates, and making more use of the results of scientific research themselves (Goddard J., 1997)

Despite of the benefits of university-industry collaboration for the knowledge economy and innovation, there are a number of barriers to effective knowledge transfer due to the dynamic nature of the relationships between university and industries. It was noted that the ownership of Intellectual Property becomes the most significant issue in the negotiation process and the lack of clarity of ownership of IP makes it longer and more expensive, sometimes even prevent successful knowledge transfer from university to industry (Lambert R., 2003). Thought views on IP issues vary, what is in common is that managing collaboration and partnership between university and industry is the key for successful knowledge transfer. How to develop strategies to cultivate and forge effective relationships between university and industry becomes one of the important tasks for the regional development agencies. In the report, it is recommended that regional development agencies should take an active role in building bridges between business and universities across regions and nations, and develop knowledge-based innovation.

To conclude, the report indicates that creating the knowledge economy through innovation requires the effective interactions between the university, industry and government. Universities will have to get better at identifying their areas of competitive strength in research, government will have to do more to support business-university collaboration and Business will have to learn how to exploit the innovative ideas that are being developed in the universities (Lambert R., 2003).

#### **4.2.3 The Science & Innovation Investment Framework<sup>1</sup>**

The Investment Framework (published in July 2004), set out the Government's strategy for making Britain one of the most competitive locations for science, research and development and for innovation. The framework announced a long-term objective of raising overall expenditure on R&D to 2.5% within ten years, from the current level of 1.9%. Achieving this will require substantial and sustained real terms increases in both public and private sector investment. One of the main commitments of the science & innovation framework is the government's response to the Lambert Review of Business-University Collaboration and the establishment of Science and Innovation Council as the strategy for implementing the knowledge economy.

At the regional level, Regional Development Agencies (Volberda H.W.) are required to build up regional economic strategies that include innovation – which is the key driver for the knowledge economy. It is also proposed to establish the Science and Industry Council (the function and roles of Science and Industry Council will be explained further in 4.4.1) which acts as regional advisory bodies that bring together science, technology and business representatives. The Science and Industry Council provides a mechanism for RDA to engage with the knowledge base, whether it resides in research institutes, universities or leading edge companies located in the region. Their memberships are generally industry-led, with senior representatives from higher education and Research Councils. The SIC provides strong leadership at regional level and can also make a significant contribution to the development of national policy. In terms of developing the collaboration between universities and industries and enhancing the role of university played in creating the knowledge economy, Lamber (2003) recommended that a greater role for the regional development agencies in facilitating knowledge transfer in the region, in doing so, ‘.....new forms of formal and informal networks between business people and academics, including the establishment of business – led Centres of Excellences to exploit and explore knowledge between the universities and industry.....’.

It is believed that the new organizations which are created to bridge the knowledge gap between universities and industries will play the significant role in facilitating knowledge transfer and innovation through the formal and informal networks established in the region. However, setting up the strategies is just a warm up, the most important is how they are implemented in the specific context. As Prescott (2000)<sup>2</sup> noted: ‘we welcome the visionary, ambitious and persuasive approach set out by the strategies. It is clear considerable energy, enthusiasm and effort have gone into their production. Now we need to see the strategies put into action’.

---

<sup>1</sup> <http://www.innovation.gov.uk/innovationreport/>

<sup>2</sup> Speaking at a seminar in Derbyshire of the eight RDA Chairman, formally presenting the Central Government responses to the Regional Economic Strategies (Department of Environment, Transport and Regions (2000) ‘regional development agencies strategies – all systems go’ DETR Press Release 017/2000

The next section will look at how the knowledge based Science & Innovation Policy is implemented in a specific region, North East of England.

## **4.3 Creating the Knowledge Economy in the North East of England**

### **4.3.1 Context of North East of England**

North East of England, as one of the smallest regions in the UK, has been historically recognized as the poorer, less innovative and fragile of the British regional economies. Traditional industries of coal and ship building in North East have declined to the point where they no longer play a significant role in the regional economy. The drive is to replace the old industry with new advanced technology and service sectors to create the knowledge economy. Consequently, the attraction of inward investment appeared to offer potential to enhance economic base for the region (Hudson, 1995).

The pace of global economic change means that many companies in the North East are facing fierce international competition. The challenge for the North East is to invest in its own infrastructure and create its unique competitiveness to attract potential investors from the global companies since potential investors are seeking for locations that offer a high quality of life, excellent education and modern infrastructure for the development of their business. The North East has seen massive changes and developed various initiatives and strategies to embrace the pace of innovation and enhance the abilities to transform great ideas into innovative products and competitive process.

For two decades the North East successfully attracted significant foreign direct investment from throughout North America, Asia and Europe. There is now intense competition for this kind of investment from other UK regions, from parts of Western Europe and from East European countries set to join an enlarged EU. The Region has been trying to improve its overall offer to investors, for example, through a region wide endorsement and coordination of quality sites earmarked for inward investors, and also identifying priority industries that can be encouraged to locate in the North East. According to the Global Entrepreneurship Monitor 2002, the North East has the

second highest level of technology start-ups outside of London. The economic strengths of the region is also addressed by Benneworth (2004b) who argues that although the chemical industry in the region has reduced its size, did successfully diversify in the post-war period and the pharmaceutical industry has to date been successful in the region and more latterly, some diversification into biosciences has taken place. In addition, there are a number of exemplar local innovating firms which have grown and created new employment. There have been some new knowledge-intensive business service created, in engineering consultancy, for example and the public sector, health and education particularly, are important sources of high productivity, high value added employment.

Despite of the identified economic strengths, the major concern for the regional government is that the region's relative wealth with respect to the rest of the UK has dwindled in the last thirty years. Evidence shows that there has been recurrent failure by industry to invest in creation of new forms of knowledge and develop sustainable competitive advantages based on knowledge-based innovation ((Benneworth, 2005). The interpretation from government perspective is that the science and technology based innovation in the region has not yet been fully explored to maximize its potential for new knowledge creation. Therefore policies have been geared towards the adoption of the regional science & innovation policy to exploit the benefit of the regional science base. Innovation is regarded playing a vital role in the knowledge economy, and encouraging innovation is an important part of economic development policy. Knowledge-based innovation is increasingly seen by the UK Government as an important element of regional policy and a way to improve regional and national productivity and competitiveness. In 1990s, UK policy makers began to emphasize ideas of developing regional innovation and encourage less successful places to identify key industry sectors in which they had technological advantages and lead positions (CURDS (Centre for Urban & Regional Development Studies);, 2004).

The Science, Engineering and Technology base of the North East is a key regional asset able to generate new products, processes, and services in the region's businesses, and to create an attractive environment for investment, growth and sustainable employment. This was recognized in the 1999 version of the Regional Economic Strategy *Unlocking Our Potential* and activities developed to advance this as part of



the business competitiveness agenda. Developments since 1999 have meant that SET policies and activities have been made considerably more explicit in the 2001 version of the Regional Economic Strategy - *Realising Our Potential*(ONE, 2001).

Following North West and Scotland, the North East was the third UK region to adopt a science and innovation strategy in attempt to coordinate the economic benefits of the regional science base and improve the regional competitiveness. Consequently, the knowledge-based innovation strategy was created as the heart of the regional economic development by the regional development agency to deliver the science and innovation policy and bridge the gap between knowledge creation and knowledge utilization.

#### **4.3.2 Raising the Potential of North East Research Base – ADL Review**

A detailed review undertaken by Arthur D Little (ADL) Cambridge Consultants was commissioned between April and July 2001 and involved engaging with well over 200 people through interviews, meetings and round-table discussions. The purpose of the review is to provide an up-to-date appraisal of the state of the research base in North East England in relation to the current and likely future needs of key industry clusters. The review included an assessment of the quality and effectiveness of links between the research base and industry, and the development of recommendations for more fully exploiting the potential of the Region's research base for economic development.

It is identified that The North East research base exhibits a number of real strengths, but the overall picture is one of comparative weakness. Although the university sector is broadly holding its own in UK terms, and some really strong private R & D assets are evident, the general level and trend of private sector R & D, and the near-absence of non-university public research, are causes for serious concern. The Region's strengths embrace both fundamental sciences and applied areas, notably medical physics. The private sector research base is overwhelmingly dominated by chemicals, materials and specialties, which together account for substantially more business expenditure on R & D than all other sectors. In most of the clusters examined, there is potential for the research base to contribute significantly to the economic development of the Region. These clusters include bulk chemicals, specialties,

bioscience, electronics and nanotechnology, multimedia / digital media, offshore engineering and energy, and tourism and culture. Research strengths need to be well focused on the specific areas of opportunity for the Region (ONE, 2001).

Despite of a number of key strengths identified in the region, there are still some areas of concerns which are significant to the creation of the knowledge economy. In terms of building up the regional images and attracting inward investors, it is noted that the North East is widely felt to be disadvantaged in attracting top talent (both in science and in business) to the Region and in overcoming the continued disadvantages of an adverse, though outdated image and reputation. The absence of large, research-intensive firms headquartered in the North East is a further disadvantage. Therefore, how to attract international investors based on the regional strength is one of the important tasks for the regional development agency. Although it is increasingly recognized that collaboration and networking is the key for innovation and knowledge creation, it is evident that with the fragmentation of large firms in the region, established networks for collaboration and associated funding of University research are breaking down. In addition, despite of numerous intermediary and technology transfer organizations and initiatives, few appear to have made big impact.

Based on the identified areas of concerns, ADL made a number of recommendations on developing innovation strategies in the region, including:

- Setting a clear and focused business which leads through the establishment of a Science & Industry Council as the owner and driver of a Regional Research Strategy
- Making the research base much stronger by creating and enhancing a number of interdisciplinary centres of research excellence based on the key strengths identified.
- Facilitating innovation networks by creating a network organization that owned by regional stakeholders, including the universities, and with a possible venture capital stake. Such organization should provide a systematic exploitation process of the knowledge transfer in the region.
- Ensuring a supportive environment to attract large R&D investors into the region.

The recommendations were taken into account by regional development agency and in consultation with other key stakeholders in the region, thus formed part of the regional innovation strategy for creating the knowledge economy.

### **4.3.3 Knowledge-based Innovation Strategy**

The creation of the knowledge based strategy is reflected in the regional economic strategies developed by RDA in the North East of England. The regional economic strategy aims to unlock the regional potential and set out strategic framework for the broad spectrum of social and economic development in the North East of England till 2001. Creating knowledge through exploration and exploitation of science and technology is one of the key elements for developing the knowledge economy as illustrated in figure 4.1.

The competitiveness and innovation parts form into the regional innovation strategy and action plan which was launched in 2001 to take forward the innovation related elements of the regional economic strategy, of which expanding the knowledge base and commercializing the knowledge Base form the core of the innovation activities – Strategy for Success Programme.

## Regional Economic Strategy and Strategy for Success Initiative

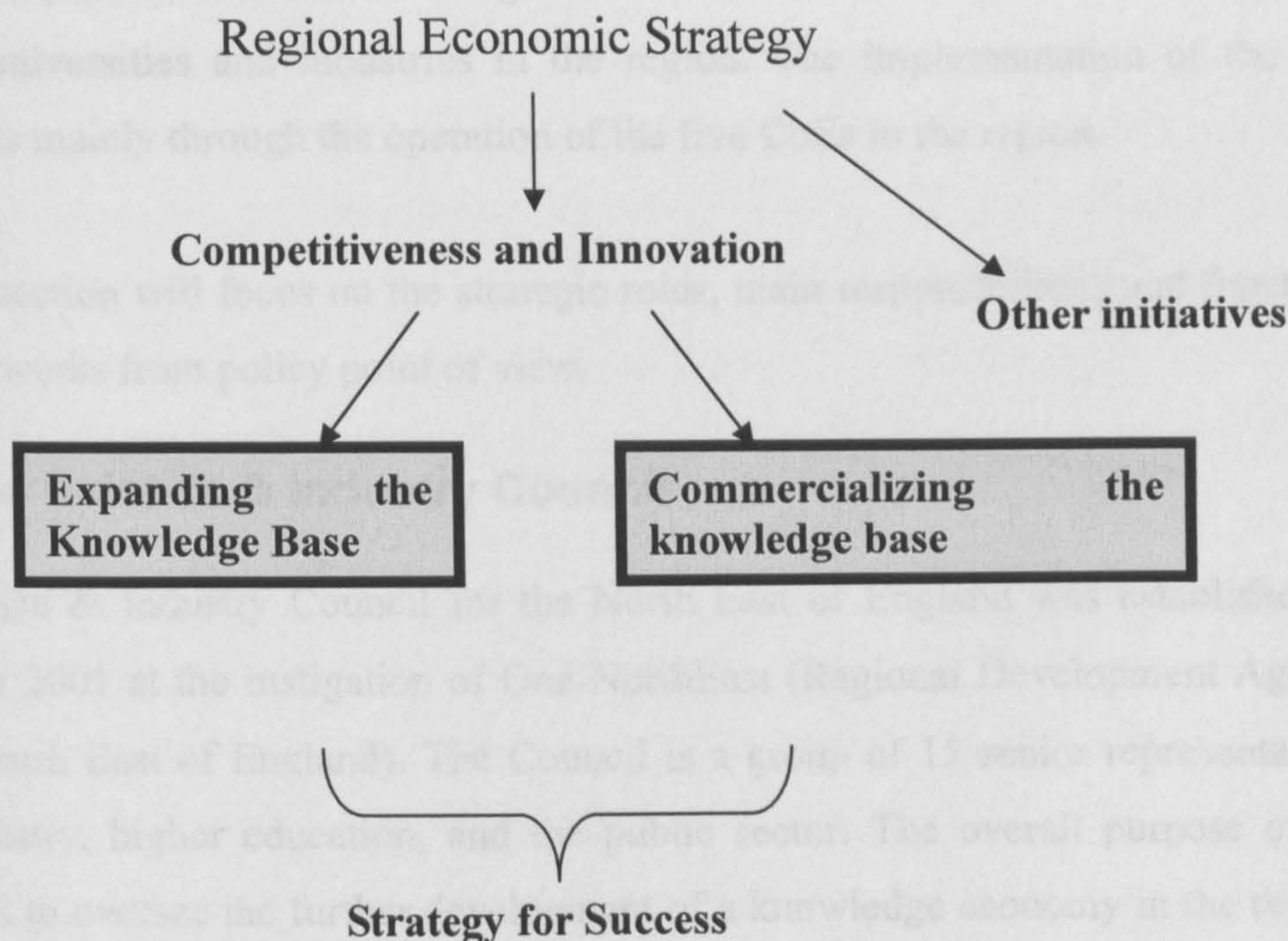


Figure 4.1 The Regional Economic strategy and Strategy for Success Initiative

### 4.4. The Formation of Strategy for Success (SfS) Networks

The Strategy for Success Programme aims to exploit the region's research base in order to generate innovation, competitiveness and growth, bring about a knowledge-driven economy, and thereby lay the foundations for the Region's future economic growth and prosperity. In 2001, One North East decided to invest on Strategy for Success Programme and directed £200 million over 5 years to the project in order to produce a clear and focused strategy to exploit regional strength, enhance competitiveness, create the knowledge economy and transform the North East's future potential. The bulk of the funding was invested in creating five new Centres of Excellence in five technology areas which were identified as the strengths of the region.

The fundamental basis of the SfS programme is to link the existing regional research strengths with key regional business sectors and facilitate knowledge transfer in the region. Thus the formation of SfS networks include various partnerships and networks with institutions and other initiatives in the region. The core networks of SfS networks

are: the science and industry council, the regional universities, the five Centres of Excellences (CoEs), which are new organizations created to bridge the knowledge gap between universities and industries in the region. The implementation of the SfS networks is mainly through the operation of the five CoEs in the region.

The next section will focus on the strategic roles, main responsibilities and functions of SfS networks from policy point of view.

#### **4.4.1 The Science & Industry Council**

The Science & Industry Council for the North East of England was established in December 2001 at the instigation of One NorthEast (Regional Development Agency for the North East of England). The Council is a group of 15 senior representatives from industry, higher education, and the public sector. The overall purpose of the Council is to oversee the further development of a knowledge economy in the region, with particular reference to overseeing the successful implementation of the Strategy for Success Programme, which is part of the regional economic development strategies to deliver the knowledge economy in the North East of England. The SIC has a high level advisory role in relation to the activities of the SfS team, and the team's progress is reported to the Council on a regular basis.

The SIC has two roles, strategic roles in terms of setting regional and national policy, and operational role in terms of overseeing the delivery of the SfS programme in the development of a knowledge economy in the North East. This will involve additional activities include working with the region's universities to enhance the research pipeline, embedding industry clusters into the SfS programme, and overseeing major physical developments that provide high quality supporting infrastructure to the science and technology renaissance that is taking place in the North East.

Above all, the SIC needs to demonstrate strong regional leadership, providing a high level forum for interaction between universities and businesses, and championing regional science and technology assets to a regional, national and international audience.

#### **4.4.2 The Regional Centre of Excellence**

Based on the detailed assessment and recommendation from ADL review and the

consultation of the key stakeholders in the region, five key areas were identified on the basis of their potential to achieve world class competitive excellence, through technology transfer from the Region's research base. The five Centres of Excellences were established during 2001 and 2002. Each of the Centres of Excellence has a different focus (Centre of Excellence for Life Sciences, Centre of Excellence for Nanotechnology Photonics and Microsystems, Codeworks, Centre for Process Industries and New and Renewable Energy Centre). The objectives of CoEs are to shape regional research to match market need, managing translational research, and effecting industrial application.

According to SfS documents, the primary function of the Centres of Excellence is to 'condition' technologies arising from the Region's research base to a form whereby these technologies can be utilized for commercial purposes. Each centre will have lean operating structures as virtual organizations which only have core coordinating staff. The CoEs also act as the focal point for the commercialization of science in the Region. The commercialization can be achieved by three principal routes:

- New companies spinning off from the science base;
- Transfer of technology to existing companies;
- Attraction of new companies or investment to the Region to link with the science base.

The CoEs act as the link between the science base and commercial applications and also seek to secure additional funding for research, transfer and business development activities, market the knowledge base and the clusters, provide intelligence on cluster needs, secure suitable equipment and related facilities and secure appropriate incubation facilities. To exploit innovation and knowledge generation, the CoEs need to enact themselves as a network organization to facilitate collaboration between various R&D groups within universities and industry. Although there will be core principles which underpin all of the Centres, no single model will be applicable for each centre. Rather, each will vary depending upon its market, technology, stakeholders and the starting point. In addition to the establishment of its primary role and function, the CoEs are also required to derive their own income streams and are aiming to achieve a financial position independent of the Regional Development Agency within 5 years.

#### **4.4.2.1 Centre of Digital Technology & Media CoE (Codeworks)**

The North East is identified having great potential in developing digital and computer-based technologies. University of Sunderland houses the largest ICT (Information and Communication Technology) training facilities in the UK and supplies more computers games graduates to Microsoft than any other UK universities. The Region is leading the way in designing and applying Grid software and is leading the UK efforts on virtual organizations on the Grid. The E-Science Centre is also a partner in the main international project to allow dataset systems to be connected into the Grid. Codeworks works with the regional universities and industries to determine its key focus of the digital sectors, which will underpin the Centre's investment strategies. Codeworks also merged with the Digital Media Network (which is the regional business networks for digital media) to create CodeWorks Connect, and with the NITRO project to create codeworks Nitro, in order to assist digital SMEs (Small and Middle-sized Enterprises) in the Region and provide a world class facility for interactive media.

#### **4.4.2.2 Centre of Excellence in Life Science (CELS)**

CELS is a leading UK Centre of Excellence for Life Sciences- it identifies and exploits cutting edge technologies that have significant commercial potential. CELS develops new concepts, forms business ventures and steers growth in global markets. In doing this, the primary objectives is to strengthen the bioscience industry of the North East of England. CELS builds on activities within the International Centre for Life, links into the Regional academic and NHS (National Health Service) research base, and provides partnering opportunities to a range of companies in pharmaceuticals, bio-processing, bioinformatics and other sectors. It also provides capital, services and management skills to drive the development of R&D partnerships and create new sustainable spin-out ventures. CELS concentrates the majority of its efforts on a number of flagship areas that are perceived to give maximum strategic market advantage to the region over the longer term. These areas are chosen because the region:

- already has good research bases in these areas
- is backed with strong clinical capability within NHS and
- has relevant industrial companies.

CELS works with universities, businesses and regional development agency to drive forward the project related to life science and works with partners within its knowledge networks to identify commercial collaborative opportunities with identified partners.

#### **4.4.2.3 Centre of Nanotechnology, Microsystems and Photonics (CENAMPS)**

CENAMPS is an international Centre of Excellence for Nanotechnology, Micro and Photonic Systems. It has established regional, national and international partners and has been actively working with industry, academia and government to create sustained technological capability via exploitation of nanotechnology, microsystems and photonics. CENAMPS' strategy is to seed collaborative R&D programmes as platforms for near market commercialization opportunities and by strengthening the knowledge base so that it can support large industry-linked projects in the region.

The centre is entrepreneurial, facilitating the development and exploitation of small scale technologies and to stimulate faster international exploitation of small scale technologies sourced worldwide. CENAMPS access to public and private investment sources, state of the art facilities, technologists and international networks provides clients with a unique competitive advantage reducing commercial risk in exploiting emerging technologies.

#### **4.4.2.4 Centre for Process Industry Innovation (CPI)**

The Centre for Process Innovation (CPI) is a Centre of Excellence set up to bring substantial benefits to the process industry in the UK. CPI is delivering its key business objectives including its research opportunities, partnering and joint ventures and building a competitive cluster. The CPI will drive forward applied research and development in the process sector through collaboration with industry partners and with world-leading research universities.

CPI develops various collaboration projects with global industry players to develop Intellectual Property Rights (IPR) and generic capability for CPI. It also develops world class capabilities in knowledge transfer, research and exploitation in collaboration with other Centres of Excellences, chemical clusters to support the industries in the region. Ultimately, the CPI seeks to build an innovative centre that



addresses the need to involve the region's universities more in industry driven projects.

#### **4.4.2.5 Centre for Renewable Energy (NaREC)**

The New and Renewable Energy Centre (NaREC) is to create and enable world-class new and renewable energy provision building up North East's industrial and academic expertise from three main areas: technology management, market management and encouraging UK leadership.

The main objectives include:

- Identifying technologies with significant potential
- Directing research and development towards market opportunities
- Identifying and overcoming constraints on the overall development of technologies for energy provision, distribution, storage and use
- Assisting new and existing business to innovate through supporting their development of new products and services, assisting the companies to secure investment and enabling market penetration for their products and services
- Developing partnerships with other centres of excellences internationally
- Becoming financially self-sustaining

NaREC was launched by the Minister for Industry and Energy in 2002. The hub of this is a commercial partnership between the Region's universities and industry and it is the centre of a national research network and the catalyst for a clustering of businesses.

#### **4.4.2.6 Nstar – Exploit the Knowledge and Technology Base**

NStar has been created to support CoE and ensure that a continuum of finance is provided to early stage technology companies. It is an independent, early stage technology venture company, established by the Regional Development Agency to secure significant new venture funds for investment in university spinouts and technology business across the region. The primary role of Nstar are:

- Attracting funds to finance the development of new technology businesses in the North East,

- Collaborating with the five technology-led Centres of Excellence, universities and businesses on a broad range of issues including the provision of early stage finance for technology start ups SME, and
- Coordinating projects, creating a ready flow of investment opportunities with the future potential to become high growth and sustainable technology business.

The financial measures have been established include Proof of Concept Fund and Co-Investment Fund, and Special Purpose Equity Vehicle. The most advanced of these measures are the Co-Investment Fund and the Proof of Concept Fund. Nstar provides commercial expertise and work with other business support organizations to enhance the exploitation of intellectual property generated by research activities.

#### **4.4.3 Regional Cluster Networks (RCN)**

One of the key elements of the SfS programme linking to the industrial aspects of innovation is through the development of the regional cluster programme. Clusters have been analyzed by many innovation researchers and economists. For example Beccatini (1990) uses industrial district to describe cluster to be characterized by the strong interplay between the fabric of social relationships and network of economic production exchanges. Overlapping production and social linkages facilitate information and knowledge sharing, trust and cooperation. Therefore firms and people are embedded in a socio-cultural context that generates dynamics processes of knowledge creation (learning and innovation) and knowledge transfer (diffusion and synergies)(Andriani et al., 2005).

The regional clusters represent the key industries and R&D drivers in creating the knowledge economy in the region. It is recognized that clusters are concentrations of competing, collaborating or interdependent companies and institutions connected to one another through market and non-market links (ONE, 2001). The North East clusters development programme aims to create business led innovative firms backed by a responsive public sector and strong research base in the region.

The cooperative approach is determined by sector affiliation and also depends upon other business interests where networking offers clear economic benefit to participating firms. The North East region's approach recognizes three approaches

clustering development in terms of enhancing established competitive clusters, creating new globally competitive clusters and clustering for competitive advantage.

The cluster development programme aims to address the key issues facing existing clusters, removing the barriers to growth, foster an environment and create business opportunities and resources to support their R&D development and growth. This involves initiatives to increase competitiveness, productivity, raise skills and improve infrastructure. As well as continuing supporting existing industries, the cluster programme also aims to support the CoEs to create new clusters that will exploit technologies being developed within the Region's universities and commercial R&D activities. Charles and Benneworth (2001) point out that attention should be paid to the different focuses between clusters and clustering. Clusters are perceived as self-generating groups whereas clustering means the process of facilitating clusters. Thus the government should focus on promoting the linkages between firms and facilitating collaboration in the identified key industries that can bring broader benefits to the regional knowledge economy.

The cluster programme begins with the mapping process in order to develop a fully understand the nature of a cluster, its members and the way they interact. Once a cluster's potential and needs are known, activities and projects are devised to exploit opportunities and support its development. Within the region, 14 clusters have been identified as the key industries in the region, including Automotive, Base Chemicals, Bioscience, Clothing and Textiles, Creative Industries, Defence and Precision Engineering, Digital Electronics, Environmental Industries, Food and Drink, Nanotechnology, Offshore, Pharmaceuticals and Speciality Chemicals and Tourism.

It is obvious that the North East Region possess great potential for developing the competitiveness of region in the knowledge economy. However the challenges facing the government agencies are how to develop strategies to exploit new global competitive clusters as well as continuing supporting existing business sectors.

#### **4.4.4 Inward Investment Networks (IIN)**

Innovation should be viewed an internationally distributed system in which parts of this system are highly concentrated in a limited number of city-regions, the dynamics of innovation need to be related to both concentration of local strength of clusters and

international linkages (Simmie, 2004). In addition to strengthen the knowledge base in the region, inward investment is regarded as one of the important strategies for developing regional economy through attracting high profile international companies to invest in the region. Attracting global R&D investment therefore becomes one of the key elements of the knowledge-based innovation strategy. Potential investors are looking for locations that offer a high quality of life, excellent education and modern infrastructure. The knowledge based innovation strategy should be designed to further strengthen the Region's competitive advantage (ONE, 2002).

The link between Foreign Direct Investment and Economic Development has been well recognized by economists and government decision makers. Where there are associated firms in the same areas of technological company, there is the potential for the positive interaction and knowledge flow between the business partners. Cantwell (1999) indicates that there international knowledge flows, particularly within the firm, will become increasingly important over time. This is the characteristic of the knowledge based economy. This view is also supported by the recommendations from by ADL (2001) report is to create a supportive and quality environment to attract global R&D investors into the region.

The regional Inward Investment Team (IIT) was created within One Northeast. The IIT integrates the activities of sub-regional partners, and draws on the expertise of business development professionals within the region and work across an international network of offices to effectively promote the North East region and deliver the investment services to potential investors. Although inward investment is not within the key components of SfS Programme, the inward investment activities are closely linked with the knowledge exploitation and innovation activities performed by SfS Programme.

The inward investment teams based in ONE, aims to attract global R&D investors by providing:

- Single point of contact for enquires from the market,
- Project Management from enquiry through to start-up

- Access to University Programmes, regional initiatives, networks, finance, local authority support
- Services such as identifying property solutions, introduction to solicitors, accountants, consultants
- After care service once companies are settled down in the region and ongoing support
- Market focused and responsive to changes in global inward investment trends.

## **4.5 University Research Networks (RN)**

Universities have been increasingly regarded playing the significant role in the knowledge economy. The North East universities, as the centre of the regional knowledge-based strategy, offer considerable expertise and research in supporting the knowledge generation and application. Among the five universities in the North East, each university has its own specific research strengths and operate in a different approach in knowledge transfer process through interacting with industries. For example, the traditional research oriented Durham and Newcastle have strong base in medicine and bioscience, whereas the new universities such as Teeside, Sunderland and Northumbria are highlighted in virtual reality and food, computer science, and design etc.

The knowledge transfer between university and industry is a dynamic process which involves various stakeholders and the knowledge transfer activities can take different forms from academic personal contact, university research centre, government funded knowledge transfer scheme or university business arms which is affiliated to the research institutes. In principle, the commercialization activities are managed via the University Technology Transfer Office (TTO). Other forms of knowledge transfer can be conducted through include Knowledge Transfer Partner scheme, University Enterprise Centre or other consultancy activities academic staff involved.

### **4.5.1 Technology Transfer Office (TTO)**

The role of the TTO is to facilitate commercial knowledge transfers through the licensing to industry of inventions or other forms of intellectual property resulting from university research. The TTO acts as a source of financial gain to universities

and industries and also as the key drive to change university culture from traditional educational institution to the business led knowledge centre in the knowledge economy. The key stakeholders of the TTO include university scientists, who discover new technologies; the technology transfer managers; who manage the licensing contract and IP negotiation with industry; companies who commercialize university-based technologies; and even the government who are the sponsor of the research project can also be regarded as the stakeholder. By no means this is an exhaustive list of interest and the TTO have to manage the dynamic expectations from stakeholders. As Goldhol and Lund (1983) indicate that the process is to bridge the disparate cultures of the donor and recipient organizations, and involves steps of adaptation and utilization that may change the technology into something quite different from the issuing from the source.

Given the different motivation and behaviours of stakeholders operate in different environment. It is inevitable that considerable misunderstanding and disagreement might occur. How to manage such dynamic network process of interaction and different motivations of stakeholders have imposed significant challenges for the University TTO.

In the context of the knowledge-based innovation strategy, the role of TTO becomes more important as it not only deals with existing stakeholders, but also supports the delivery of the Sfs programme for the creation of the knowledge economy. This will involve extensive network activities with the regional CoE as well as industries in the North East.

#### **4.5.2 Knowledge Transfer Partnership (KTP)**

The Knowledge Transfer Partner scheme is based on the development and extension of the old Teaching Company Scheme (TCS) which is the core business support services offered by DTI (Department of Trade and Industry/Department of Education and Employment). The core element of the scheme is the strategic technology transfer through the formation industrial/academic partnerships. The focus of KTP scheme is to help companies to access the skills and resources of the universities for strategic advantage by bringing graduates and companies together and also assist companies to innovate and develop new products/services. KTP as a technology transfer service has

been traditionally distributed along similar university outreach products via academic or research institutes contracts with Industry. With the help of local Business Link and the KTP consultants, companies can identify an academic or researcher that has the right expertise for their business. The companies can then define and agree a project that will enable them to draw on their expertise and apply it to their business.

The agreed project could be for any length of time between one and three years, with the overall aim of helping the companies' business to make a step change in the areas that are identified as high priority. The benefit of KTP for companies is that it could help to increase the profitability of business by

- Improving existing products
- Developing new products
- Streamlining a manufacturing processes
- Improving logistics processes; or
- Developing a marketing strategy

From university point of view, the key benefits of KTP for the universities are:

- The total turnover of KTP is included in the Research Assessment Exercises
- It forms one of the key selection for university applying for further funding from the government
- It can form the basis for graduates to conduct PhD level research. Although the KTP project and partnership formed are commercial oriented, increasingly the graduates can access to practical problem and the experiences gained in industry will help to develop the topics of their research.
- It also has a low cost overhead base. All cost of employing the graduates are met by the partnering company and government grant.

KTP programme, as a technology transfer service, has been distributed along similar university outreach products via academic or research institutes contact with industry. The KTP operates through various networks including professional forums, public sector initiatives and academic outreach links and schools. KTP has extensive links with leading private professional business support organizations and regularly attends business forum events to approach target companies. The public sector is largely dominated by the activities of the Regional Development Agency and as such KTP

has been concentrated to key sector players in the newly established Centres of Excellence and cluster groups in areas such as nanotechnology, bio-sensor development, advanced medicine and renewable energy etc.

### **4.5.3 Knowledge House Networks (KHN)**

Another key player of the knowledge networks in the region is the Knowledge House. Established in 1995, Knowledge House is a collaborative venture between the regional universities in response to the government's initiative of enhancing region's competitiveness. The knowledge house service is available to all companies, organizations and individuals. It offers expert solutions for developing ideas and solving problems through collaboration, consultancy, training and research.

Knowledge House is owned collaboratively by the five universities in the region. The overall aim is to provide a single point of access to the knowledge and resources in the universities for businesses seeking assistance from academic staff such as technical or management expertise or training opportunities. Knowledge House works with other business support organizations such as business links in the region, to facilitate innovations and knowledge transfer to the region's companies.

The main programmes developed by KHN include:

- **AGREE Programme**  
The AGREE programme was developed in order to facilitate business strategy development complementing business and operational services within the organization either at corporate or departmental level. The AGREE programme is facilitated by people from KHN to join the company, understand their business and to assess the companies' strategy.
- **OSSES (One Stop Engineering Solution)**  
The OSSES is a collaborative unit within KHN combining specialists such as Rapid Product Design, Advanced Materials Research Centre from the regional university to help organizations to define, envisage, verify, engineer, lean, oversee, produce (DEVELOP) new products by providing the essential skills, experiences and cutting edge facilities.
- **Training Workshops**



KHN offers a wide range of workshops for companies seeking integration of services, improving efficiency and performance, effective recruitment & retention, and to overcome cultural and language barriers when dealing with international clients.

- **Intellectual Property Right (IPR) Strategy**

Through the links with universities, KHN also provides services to companies seeking IPR strategy through meeting with academics, discussing IPR exploitation, protection strategy

## **4.7 The Implementation of the Knowledge-based Strategy**

### **4.7.1 A Demonstration of SfS Policy Networks**

The implementation of SfS programme, as illustrated in figure 4.2, is through the operation of the new established organizations – Centres of Excellences and their interactions with other knowledge networks that have been established in the region. The initial activities of SfS are focused on the establishment of mechanisms to kick-start a step-change in regional leadership and in the degree to which the value of the Region's R&D base is utilized to maximum effect. Five Centres of Excellence – in the key technology areas of Digital Technology & Media, Life Sciences, Nanotechnology, New & Renewable Energy, and Process Innovation – were established to shape research from the perspective of market need, manage translational research and effect industrial application. Each of these Centres concentrates on building critical mass in niches where the Region has particularly significant opportunities. NStar, an early stage venture company, was created to invest in innovative technologies. The Science and Industry Council is established to provide high-level direction and advice.

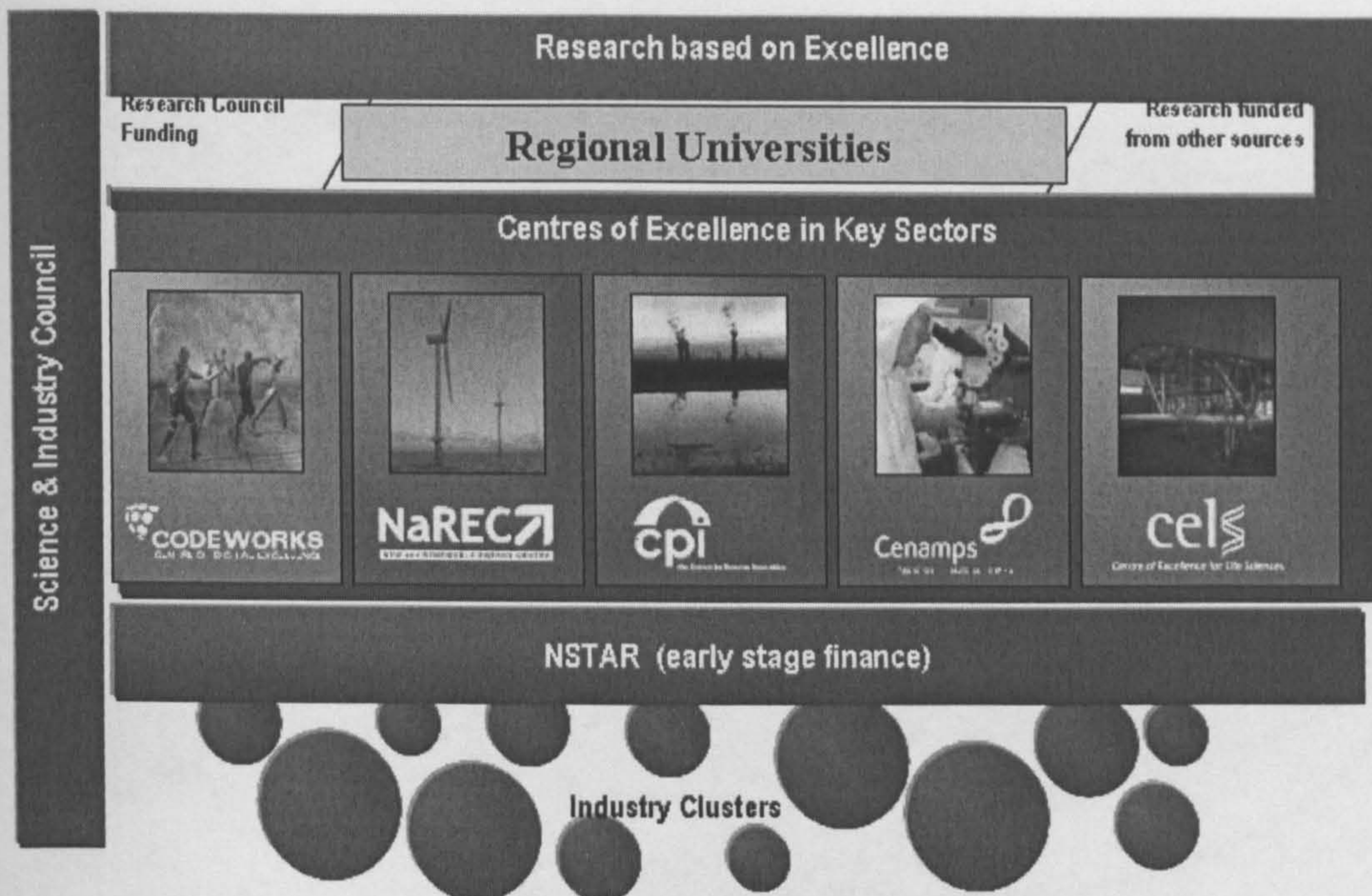


Figure 4.2 Organizational structure of Strategy for Success Networks

#### 4.7.2 The Conceptual Mapping of Triple Helix Innovation Networks

The success of SfS programme can not be achieved without effective interactions with other initiatives and knowledge networks that have already taken place in the region. Through the analysis of the policy networks, other key knowledge initiatives that play an important role in working with SfS programme have been identified. These knowledge networks together with the SfS networks help to draw an overall picture of the framework knowledge-based innovation in the region. Figure 4.3 shows the overall policy networks, which provide fundamental knowledge infrastructure of the North East region. It also maps out the institutional relationships which need to be activated and maintained when implementing knowledge based innovation strategy.

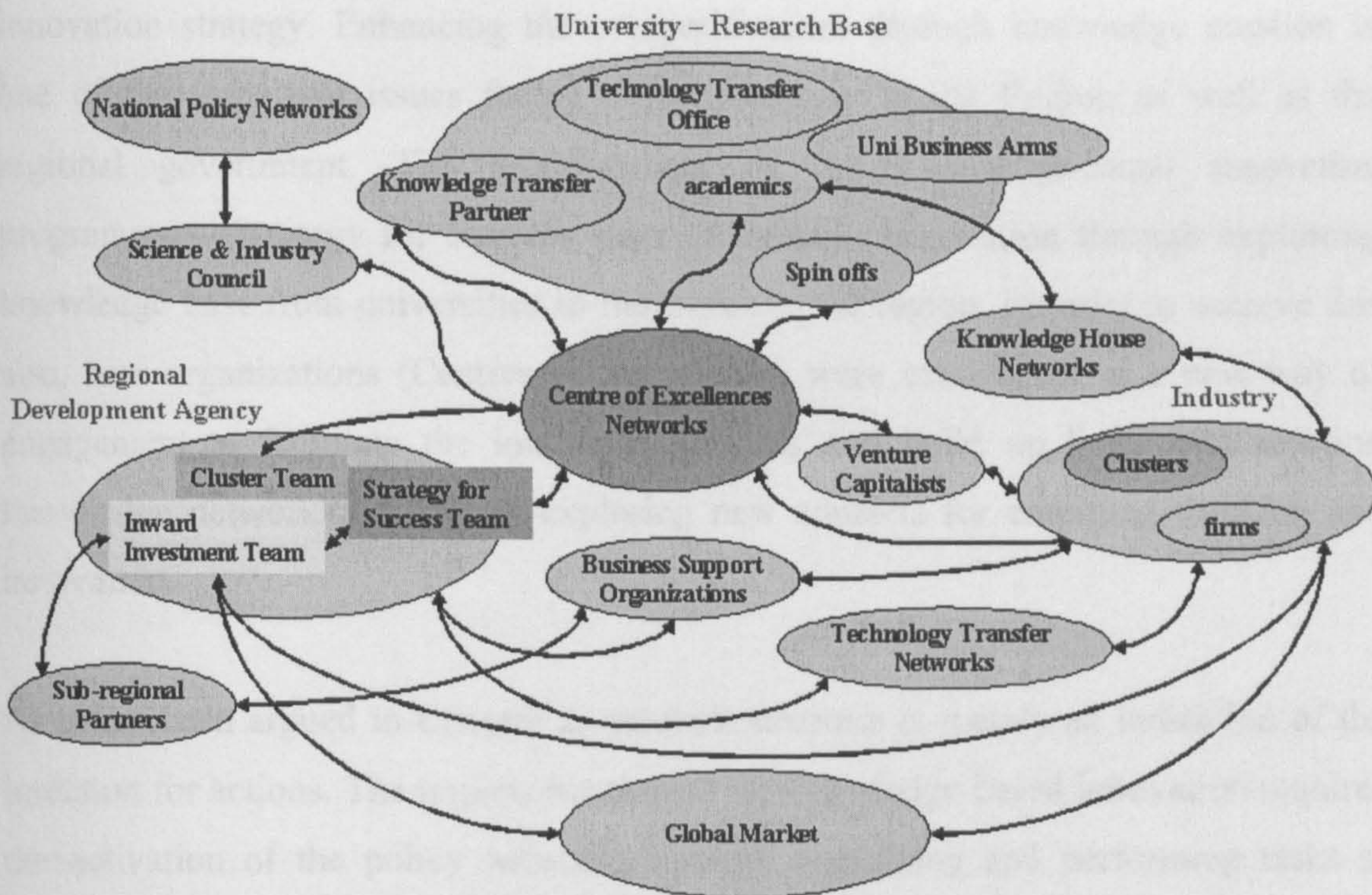


Figure 4.3 The Strategy for Success Innovation Networks

From the map, it shows that performing the knowledge-based innovation strategy requires the CoEs interact with a wider range of public and private actors and networks in the region. These actors include venture capitalists, regional companies and clusters, government agencies and development teams, policy advice institutions (Science & Industry Council), university technology transfer office, individual academics and spin off companies. It is in this dynamic networking environment that the CoEs teams perform their role as facilitators to build up and maintain networks for knowledge creation. However it should be noted that the connections shown on the map does not necessarily suggest actual interaction at operational level, nor does it denote the quality of relationships or the effectiveness of information flow. The process of interaction within the knowledge networks and how operational as well as institutional relationships are developed and maintained will be examined, analyzed and discussed in the following Chapters.

## 4.8 Conclusion

This Chapter presented the overall policy networks developed from the knowledge-based innovation strategy in the North East region. The purpose is to provide the map of institutional structures embedded in the implementation of the knowledge-based

innovation strategy. Enhancing the competitiveness through knowledge creation is one of the important issues facing every company in the Region as well as the regional government. The establishment of the knowledge-based innovation programme – Strategy for Success aims to facilitate innovation through exploiting knowledge base from universities to industries in the region. In order to achieve this aim, new organizations (Centres of Excellence) were established as a new way of engagement to facilitate the interactive process and build up links with existing knowledge networks as well as exploring new contacts for emerging thinking and innovation.

As it has been argued in Chapter 2, network structure is merely an indication of the intention for actions. The implementation of the knowledge-based innovation requires the activation of the policy networks through organizing and performing tasks at operational levels. It is at this point that the investigation of the interactive process of those innovation actors becomes essential to understand the dynamics of knowledge creation.

The next Chapter will present the preliminary findings from the pilot study based on the investigation of the regional inward investment networks and the issues generated from the process of organizing and performing innovation networking.

# **Chapter 5 A Pilot Study of Regional Inward Investment Networks**

## **5.1 Introduction**

As an important part of the research strategy, a pilot study was designed to test the theoretical issues and provide an initial understanding on the nature and process of regional innovation networking. A detailed rationale and philosophical issues underlying the pilot study were discussed in the research methodology in Chapter 3.

This chapter will focus on the substantial findings from the pilot study, which is based on the investigation of the inward investment networking process in the North East of England. It should be pointed out that the interpretive and qualitative nature of current research design does not intend to generate statistical application or economic indicators based on the amount of investment made and numbers of global firms located in the region. Rather the pilot study was designed to identify the nature and process of regional innovation by studying the implementation of inward investment strategy, which has been regarded as an important part of regional innovation and economic development. Consequently the attention will be paid on how inward investment strategy is translated into practice through interactive networks created and organized by innovation actors from different institutional context.

This Chapter will start by highlighting the importance of attracting inward investment as part of the regional economic development strategy in terms of enhancing the international profile of the region and linking the region with global sources of innovation. Thus developing and implementing an effective regional inward investment strategy not only helps to bring in new knowledge into the region, but also facilitates local firms accessing to the global market and developing sustainable competitive advantages.

Section 5.3 will explore the nature and content of the inward investment networks and the activities involved in building and maintaining innovation networks including the process of communication and information flow between innovation actors. Initial findings and issues identified during the process of pilot study will be discussed and

analyzed in Section 5.4. Finally, conclusions and implications for main study will be highlighted at the end.

## **5.2 The Inward Investment Strategy and Knowledge Economy**

### **5.2.1 Regional Inward Investment Strategy**

Regional inward investment strategy is designed and implemented by the One North East (ONE) which is the Regional Development Agency in the North East Region. ONE is responsible for the regional economic development with enhancing innovation capacities as one of the key tasks for the regional government.

The North East inward investment strategy has been illustrated in the figure 5.1. The main aim for the inward investment is to attract global R&D investments and projects into the North East region to expand the knowledge base of the region, enhance regional innovation capacities and sustainable competitive advantages. In doing so, the inward investment team has the following objectives in terms of providing existing and potential investors:

- Single point of contact for enquires from the market,
- Project Management from enquiry through to start-up
- Access to University research expertise, regional initiatives, networks, finance, local authority support
- Services such as identifying property solutions, introduction to solicitors, accountants, consultants
- After care service once companies are settled down in the region and ongoing support
- Market focused and responsive to changes in global inward investment trends.

The objectives stated above are manifested in an inward invest target model shown in figure 4.2. In the centre of the model, the marketed focused innovation activities is clearly an indication of the regional focus in developing the knowledge economy which is driven by the changing demand for new product and knowledge in the global market.

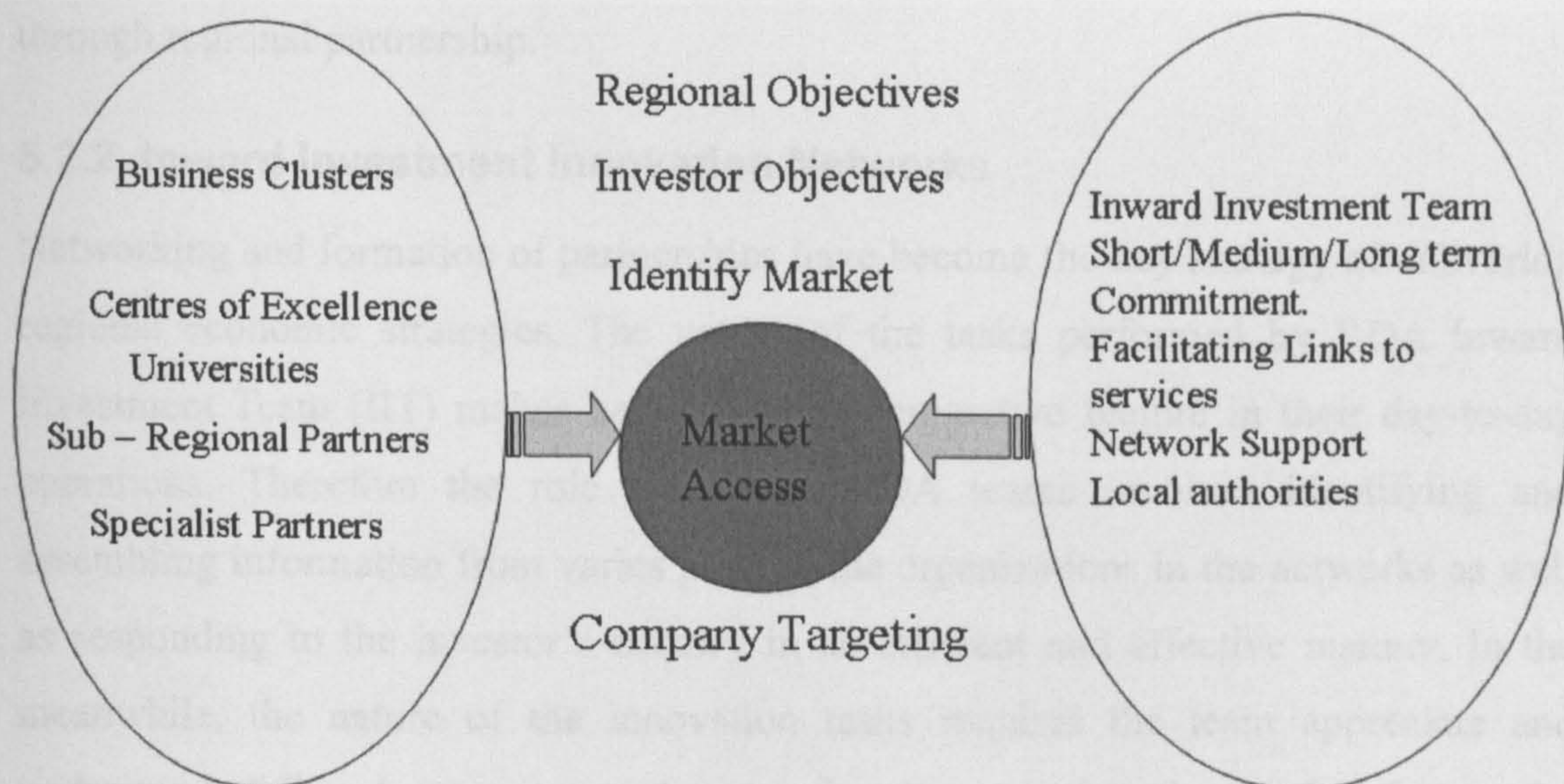


Figure 5.1 Inward Investor Target Model

The inward investment target model reflects the prevalent regional innovation paradigm in creating networks and partnerships with a wider range of actors within and across organizational boundaries. In addition to working in partnerships with regional firms, universities, sub-regional partnerships and other business support organizations (referred as specialist partners), the inward investment team also has to identify the needs of potential investors and match their objectives with regional innovation target in the identified market.

In terms of the operational mechanisms, the model also highlights the importance of commitments of network participants, the facilitating roles of network managers, and the support of local innovation networks in providing sufficient information required by potential investors so that an investment decision can be made. The success of inward investment strategy plays an important role in knowledge generation and regional economic development in the sense that it helps to promote the region to the global market and also open up the information and knowledge channels for regional firms and research to benefit from global R&D as well as create new innovation opportunities in the region.

Despite of the strategic intention and well-designed policy networks for regional innovation, the delivery of the market-focused inward investment strategy cannot be achieved without developing and maintaining the diverse innovation networks

through regional partnership.

### **5.2.2. Inward Investment Innovation Networks**

Networking and formation of partnerships have become the key strategy of delivering regional economic strategies. The nature of the tasks performed by RDA Inward Investment Team (IIT) makes networking an imperative feature in their day-to-day operations. Therefore the role played by RDA teams involves identifying and assembling information from various parts of the organizations in the networks as well as responding to the investor's enquiry in an efficient and effective manner. In the meanwhile, the nature of the innovation tasks requires the team appreciate and understand different corporate and national culture so that the needs of potential investors can be identified and appropriate facilitation can be organized.

In order to deliver the inward investment strategy, a formal partnership agreement was formed between the regional development agency and the sub-regional partners (SRP) in the North East region. In addition to the formal partnership agreement, the IIT also works via informal networks with other regional partners including universities, industrial clusters, business consultants as well as other business development teams within RDA in seeking and sharing specific information and resources that can be used to attract potential investors.

Under the formal agreement, the IIT and SRPs need to support each other on providing project-related information, project management activities as well as customer care to firms that have re-located or established new operations in the region. The IIT in RDA consists of several geographic-based teams. Each team has the responsibilities for attracting investors from a number of target countries. The IIT works with project managers from SRPs on various investment projects and events. Figure 5.2 demonstrates the innovation networks of IIT for conducting inward investment activities. The solid lines imply direct communication networks between IIT and innovation actors from other regional partners as well as business managers within the SRP. The broken lines refer to the formal partnership networks between IIT and SRP.



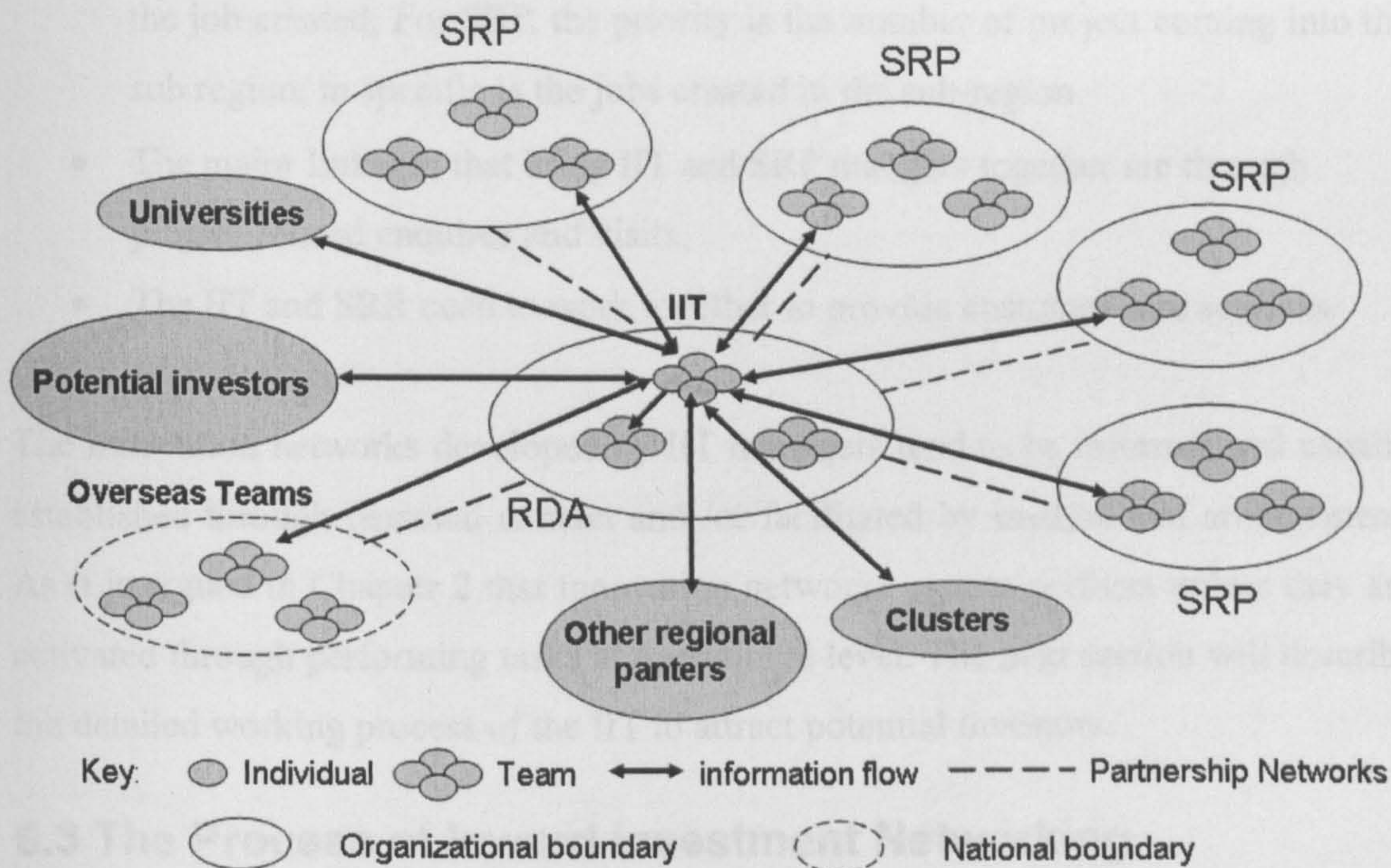


Figure 5.2 Inward Investment Innovation Networks

There are two types of innovation networks that the IIT has to maintain regular interactions to perform networking tasks. One is the networks that are formed through formal partnership agreement with SRPs, the other type of networks are developed via institutional or individual contact with other regional institutional partners and business support agencies. Different nature of the innovation networks leads to different types of the relationships between IIT and other network partners through either formal or informal interactions.

The nature of the formal partnership between IIT and SRP networks are described as below:

- The formal partnership agreement provides organizational arrangement and network structures thereby the roles of IIT and SRPs are defined in terms of working together as a virtual team
- The IIT and SRP share a strategic common goal, i.e. to attract global R&D investors into the region.
- Under the umbrella of regional inward investment strategy, it is noted that SRPs have different set of aims for attracting investors into the sub-regions;
- For IIT, the concern is about the number of project in the region, in specific is

the job created; For SRP, the priority is the number of project coming into the sub region, in specific is the jobs created in the sub-region.

- The major linkages that bring IIT and SRP managers together are through project-related enquires and visits.
- The IIT and SRR need to work together to provide customer care services.

The innovation networks developed by IIT managers tend to be informal and usually established through personal contact and /or facilitated by institutional arrangement. As it is argued in Chapter 2 that innovation networks cannot perform unless they are activated through performing tasks at operational level. The next section will describe the detailed working process of the IIT to attract potential investors.

## **5.3 The Process of Inward Investment Networking**

### **5.3.1 Principles of networking**

The inward investment does not have a standard form. It involves different forms of activities such as job creation in short term, medium or long term, investment, joint venture, collaboration between externals and research department, or collaboration between research departments of North East universities and externals.

The main aim for the IIT, according to IIT senior managers, is to provide project management and expertise for clients.

At the operational level, the IIT operational manager said, our job is to bring companies to the region, to establish business, our day to day tasks involve identifying clients and potential projects that suits the regional strengthens. The project could be academic related, or anybody who are interested in setting up facilities or collaborative research, or joint venture partnerships. We organize programmes for companies to make it easier for them to come to the region and meet with relevant people. We also help them with financial assistance etc.

With regard to how the inward investment contributes to the knowledge economy, it is explained by a IIT senior manager, that if we identify a company that is seeking to develop a new product in certain technology area, we then help them to access to

relevant resources in the university. They hopefully and eventually create new products. That will help to generate knowledge driven employment in the region.

Although the process sounds simple, the actual tasks involved in innovation networks include providing information to potential investors, identifying investment requirement and needs, matching with regional infrastructure and resources, arranging visits and assisting set up new operations etc. Performing the tasks require various source of information and knowledge on the content and context of the investment project. During interviews, it was discovered that different terminologies were used to refer to the activities in the networking process for attracting investment projects. These terminologies are defined as below in order to identify the meaning of the innovation networks and the actual tasks performed by the network managers.

*Investment related Enquiry* – Referring to a piece of message either through email or telephone, from potential investors, asking for information on properties, financial services, marketing, communications, labour skills and demography in the region. The nature of an enquiry could be either general or specific information about the region or sector situation.

*Investment related Visit* – A visit could be two types. One tends to be a result of an enquiry and a visit may lead to further investigation on investment. The other is in nature a good will visit, which is helpful for building trust relationship and might lead to an enquiry. This type of visit is in general a result derived from the IIT's international marketing effort in the target country.

*Investment Project* – The account of an investment project appears to be ambiguous and complex. It can be used to refer to a specific enquiry which is likely to be a potential project. In the meantime, it can also cover the investment which has already been made in the region. Observation from the research shows that the meaning of a project is also associated with project management which implies the process that covers initial attracting client, providing necessary resources and expertise, facilitating relocation or new investment and providing after care services. No what whatever the description is about an investment project means, interview shows that the common indicator for a successful project is the number of jobs created in the region.

*Customers/Client* – for mangers involved in the inward investment networks, a client

can be either potential investor or an existing investor in the region.

*Customer care* – During research, customer care takes a form of two stages: initial customer care and after care. Initial customer care refers to the process of facilitating potential clients to make decisions to move into the region. Aftercare services involve maintaining regular contacts and communications with existing investors to resolve problems and issues encountered when engaging with other regional businesses.

The formal working relationships between IIT and SRP are mainly developed through joint information processing activities related to inward investment enquires. Enquires are divided into two types: general enquiry about the region as a whole, and specific concerns on location, labour, transport etc. which are directly linked to the investment project. When IIT receives specific enquiry, the enquiry will be passed to SRP for them to fill in specific information. The operation principle is that IIT represents the region and deals with all overseas enquires about the region, whereas SRPs handle local agencies such as learning council, training organizations, property agencies. One of the SRP operational manager said: *we have to reply on IIT to provide local information to potential investors from overseas, and the IIT should not overarch SRP and deal with local agency directly.*

One key feature of the partnership operation is that IIT has to maintain neutral position in the process of networking. It is indicated by SRP SM, that *'when IIT received enquiry from overseas and disseminated to sub-regions for response, each of the SRP will put in the bids, list our suggestions, plus a sheet on the premises or standards, and match things. The information will be sent back electronically to IIT. If investors are interested, a site visit will follow. We are also monitoring the enquires coming from IIT, to make sure that we have a good chance to attract investors to our area'*

In addition, despite of the political favorite of forging partnerships to provide an integrated service or one-stop shop to customers, the comments from the SRP OM indicate that the operation of such partnerships doesn't necessarily reflect the inter-dependent relationships of working partners. It is noted that *'although government can set up the partnership agreement, there is no formal command and control relationships here, RDA represents the overall strategy of the region and in theory it*

should also mirror the strategy of each sub regions. It is hoped that we can work together by having a joint strategy. However in reality, we do have different priorities and objectives.’ (SRP operational manager)

### 5.3.2 Nature and Content Networking Tasks

Research finding shows that the networking of IIT is highly project and task-oriented. Attracting inward investment from overseas covers various sizes of the projects crossing different business sectors which require both proactive and reactive strategies of operation, therefore the nature of the interactions within the inward investment networks is dynamic and complex. The main activities conducted by IIT and SRP are described in table 5.1.

IIT	SRPs
<ul style="list-style-type: none"> <li>• Reactive</li> <li>- Receiving enquires</li> <li>- Pass to SRT</li> <li>- Response quickly</li> <li>- Change enquires into visits</li> <li>• Proactive</li> <li>- Arrange delegations (visit)</li> <li>- Organizing local events, seminars</li> <li>- International Marketing (seminars)</li> <li>- Liaison with overseas offices</li> <li>- Frequent international trip ( may not be contactable)</li> </ul>	<ul style="list-style-type: none"> <li>• Reactive</li> <li>- Feed information back to APT</li> <li><b>Property (main); Demography</b></li> <li><b>Financial ; Market</b></li> <li><b>IT structure; Labour, skills</b></li> <li>- Response quickly</li> <li>- Change enquires into visits</li> <li>- Supporting on visits and other activities</li> <li>- Providing detailed customer care</li> <li>-Introduce local authority</li> <li>-Utility company</li> <li>-Funding organization</li> <li>-Property agency</li> <li>-Training organization</li> </ul>

Table 5.1 the networking activities of inward investment

It is understood that IIT, which represents the region as a whole, should take the lead of the innovation networks. The IIT acts as a marketing function for the region to promote the region in target overseas countries through attending various events, exhibitions, conferences and trade missions etc. By taking the advantages of its overseas networks, the IIT should be responsible for identifying quality projects for the region. The role of IIT, as noted by the IIT OM, is that ‘*We provide one point contact in the region, the company only needs to contact us and we deal with the rest of the world.*’

According to the interviews, IIT described their role in the networking process as

proactive and reactive. It is proactive in the sense that IIT has to develop the marketing strategy to promote the region in the global market by organizing various events and visits in order to generate interests in the region. Being reactive means that the IIT also needs to quickly respond to enquires or visits which they received directly from potential investor or indirectly from the overseas office. In contrast to IIT, the role of SRP in the inward investment networks tends to be more reactive due to the nature of the partnership relations. This is mainly because that the action of the SRP has to reply on enquiry supplied by IIT. Despite of different roles, the partnership relations is described as supportive working relations.

### **5.3.3 Communication**

The communication process within inward investment process is identified at two levels. On one hand, the communication is concerned with the relationships between IIT and SRP at organizational level. On the other hand, the communication is reflected at operational level between individual investment managers. Evidence shows that communications at individual level between IIT and SRP is very open, flexible and supportive because there are only small numbers of people within each team. The communication mechanism between teams is mainly by email. Telephone and face-to-face communications are also used when the project is complex and time frame is involved.

#### **5.3.3.1 Channels of communication**

Research finding reviews that despite of the spread use of email in the exchanges of information in the networks, traditional mediated communication such as telephone and face-to-face are preferred in this research context. Figure 5.3 and 5.4 shows the comparisons between the current communication mechanisms adopted by the existing innovation network managers and the expected communications mechanisms by team members.

It should be noted that the charts are based on data collected from the answer to the questions of 'how is your current communication mechanisms with your team members and to what extent do you think that is effective/not effective?' It is used here merely to provide visual aids for the explanations of the communication problems within the innovation networks

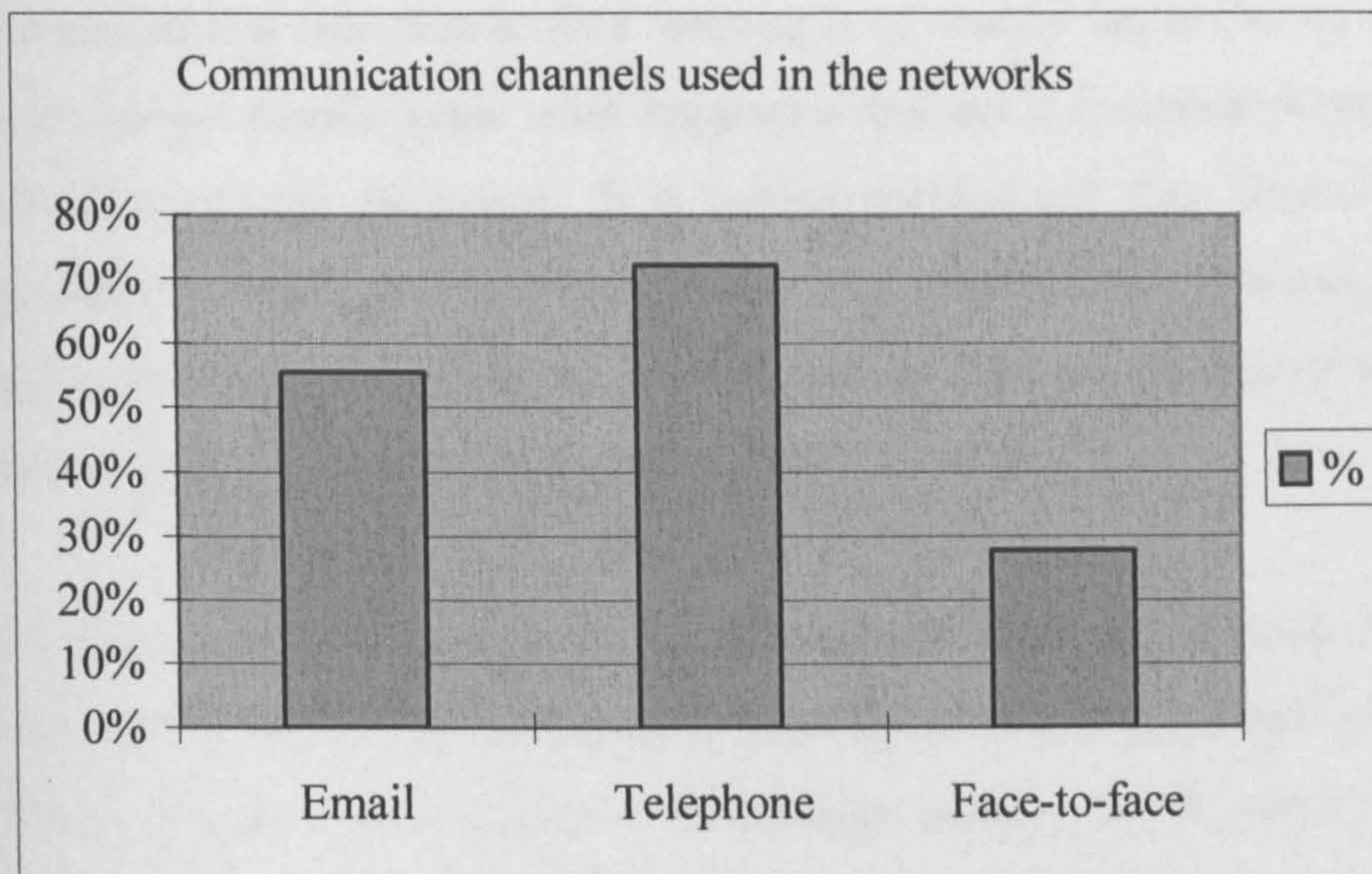


Figure 5.3 Current Communication within the Inward Investment Networks

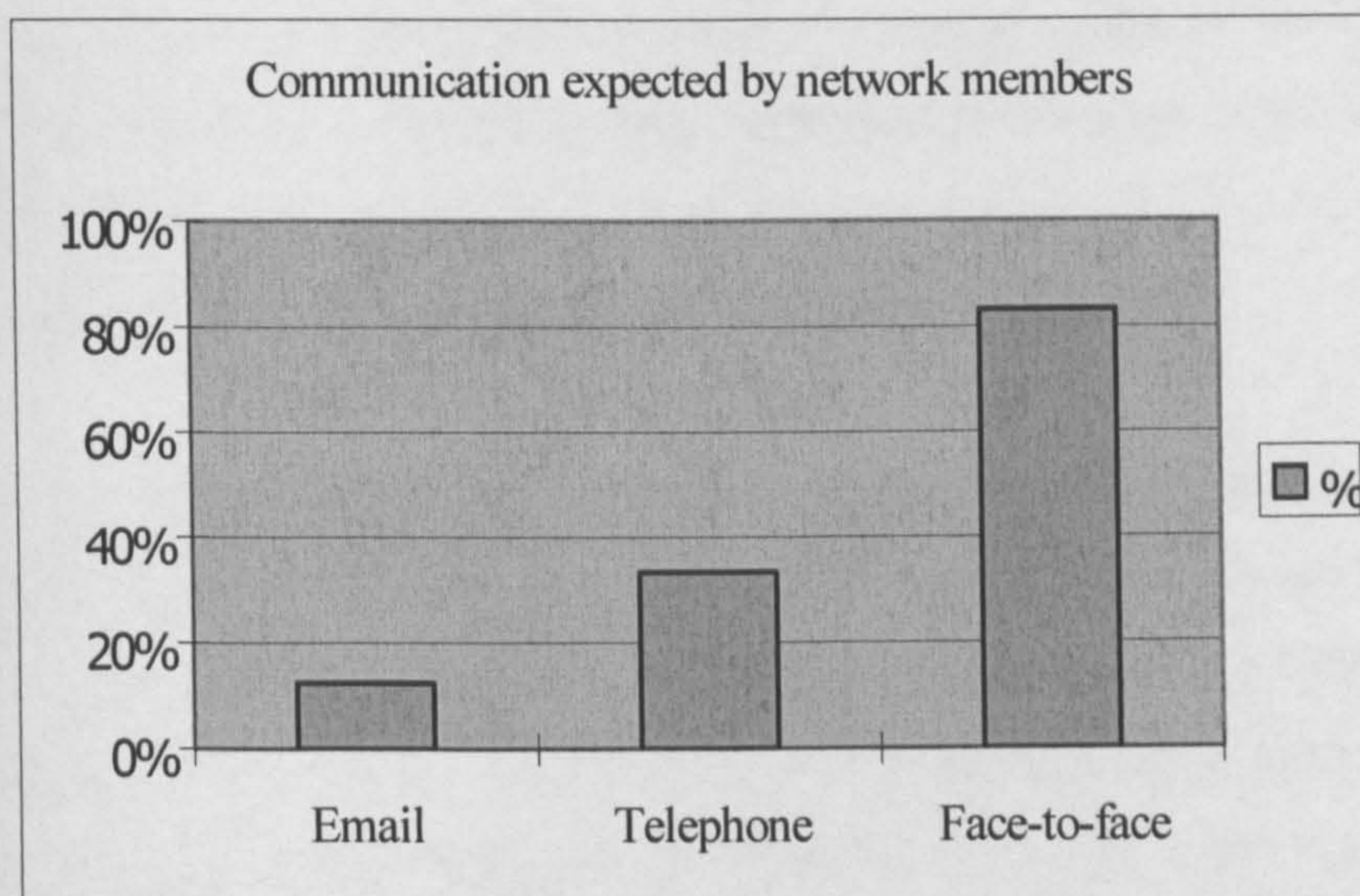


Figure 5.4 Communication Channels Expected by the Network Managers

Research findings indicate that face-to-face communication is seen as important for building up effective network relations. The SRP pointed out that *'it's all about one to one contact. We need to meet with IIT to know what their strategy and operations are, so that we can respond in an appropriate way. In the meanwhile, the IIT needs to know what we (SRP) are doing and what resources are available in our areas so that they can provide potential clients with more accurate information on the infrastructure and conditions in the region'*. (SRP OMI).

The importance of face to face meeting is also addressed by another IIT OM2. It is commented that *'the face to face meeting is of crucial important as this makes things clear and get people know what happened and get a complete picture. You get more focused on things discussed'*. It is further pointed out that *'face-to-face interaction also helps to build up trust relationships with clients. Once you meet them, it is much easier for them to respond to your follow up actions. Therefore you can facilitate them to make the investment decision'*. (SRP OM2)

Feedback from interviewees shows that the reason for using more telephone and the tendency for increasing face-to-face meeting is due to the need for processing large amount of information related to investment enquiry or projects. In order to process the information effectively and efficiently, investment managers not only need to develop knowledge on various aspects of sector and industrial related information in the region, but also have to know about the change of the global market. It is pointed out that *'we have to combine what happened in the past, what influences us in the market, what resources we have with what we want to achieve as a region. Therefore information is key in our day-to-day operation.'* (SRP OM3)

However, information can be explicit and tacit in nature. The increasing demand for new knowledge and dynamics of global market require the IIT respond to all investment related enquiries in an effective and efficient manner. In doing so, the managers have to understand the needs of investors and interpret the meaning of various information. Therefore, telephone is used before the information exchanges by email in order to established understanding and quicken the process of information exchanges. For example, IIT operational manager pointed out that *'When I have clients who want to visit the sub regions, I always give them a call before I send an email to them, because I don't know if they are able to help. If they agree, then I send detailed information to them to make arrangement. If I just sent them an email, I don't know how long to get response from them as we cannot keep our client waiting.'*

Interview shows that though email communication can be used for the purpose of document exchange or quick notice. It is only *'an enabler of communication'* (SRP OM2) and *'cannot get you more focused and concentrate. People are all very busy and they don't have the patient to read a long message, they need summery so that*



*their attention can be drawn.'* (SRP OM3)

### **5.3.3.2 Invisible Factors of Network Communication**

Despite of what is described as 'flexible and supportive working relations at individual level', it is evident that the communication at organizational level between IIT and SRP appears to be problematic. The main reason identified that hinders effective communication is associated with the nature of the innovation tasks in the network that don't seem to be fully understood and shared within team members.

Table 5.1 enumerates some invisible factors identified from interviews that have impact the communications within the network partners. The invisible factors are embedded in the specific institutional context and linked to different organizational structure and information systems. For instance, the IIT is operating under the pressure of fast changing global market therefore has to make instant decisions to secure every possible opportunities of investments. However the SRP is driven by the reactive approach and more consideration is taken on the projects analysis and rationale. Problems occur when IIT sent enquires to SRP and receives slow response, or enquires passed on by IIT did not have further response after SRP supplied with relevant information. The SRP OM3 pointed out that *'it is important for IIT to distinguish between a genuine project enquiry and a general enquiry so that we can concentrate our effort on the project enquiry that is likely to transfer to an investment project'*.

In addition, the invisible factors also include technical information and project-related knowledge which are likely to be embodied within individual and team activities. This type of knowledge is tacit in nature and can only be shared through intensive social interactions and informal networks. Network partners will not be able to react and cooperate effectively if there is lack of shared understanding and appreciation on the different working context. In the context of IIT which is dealing with the international market, the barriers coming from national culture and value differences present further difficulties for managers during the process of networking.

Invisible factors in networking		
IIT	SRP	Potential Investors
<ul style="list-style-type: none"> <li>• Fast changing and uncertainty of the international market</li> <li>• Instant decision-making</li> <li>• Internal information systems and Knowledge linkage</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge on business sectors and key contacts in the region</li> <li>• Rational analysis on projects</li> <li>• Internal information system and knowledge linkages</li> </ul>	<ul style="list-style-type: none"> <li>• National cultural values</li> <li>• Business practice (legal, finance, technology conditions)</li> <li>• Knowledge about British market and business settings.</li> </ul>

Table 5.1 Invisible Factors within Innovation Networks

### 5.3.4 Perceived Roles within Networks

Based in RDA, which is the leading organization for regional economic development, the IIT is obviously perceived as the leader for the inward investment networking. However, under the umbrella organization each SRP has its own aims and objectives for inward investment. Different interests of SRP lead to different perceptions on the roles performed by team members within the inward investment networks.

In the context of inward investment networks, IIT perceives its role as facilitator of the inward investment networks. For instance, the IIT SM said: 'we are facilitators really, we cannot impose our decisions on them (investors) unless they develop an interests in the region. So our role is to create interests and facilitate them to come to this region.' Another manager within IIT also confirmed that '*we are really the facilitator..... we introduce companies to learning council, training organization, local accountants, funding and local authority....also identify potential site, property*'. (IIT OM1)

The role of facilitator not only involves various initiatives to support potential investors, it also includes supporting SRP by supplying investment enquires and attracting investors into the region. As SRP noted that '*we have very little resources if you want to achieve our inward investment strategies, in order to maximize contact, we work close with IIT in RDA to expand our networks and promote us as sub-*

*regional area' (SRP OM2)*

However from SRP perspective, the IIT is perceived as information feeder within the networks. It is pointed out by SRP that *'we can only rely on the information provided by IIT, if they can provide full information, we can then better assist the company with relevant information. The better understanding we have to the company, the better service we can offer to potential investors' (SRP SM1)*. This view is supported by other SRP who pointed out that *'without a good understanding on the information, we can only respond based on our assumptions rather than on the fact. It has certainly led to negative impact on our quality of the response to the projects' (SRP SM2)*

The comments on the perceived roles of IIT also caused different views on the knowledge that IIT needs to develop in order to perform its role effectively. The IIT OM perceive the facilitator role requires more general knowledge on various aspects of the region, therefore can direct clients to the right contact and resources. However the SRP disagreed with this view by pointing out that IIT should develop industry expertise that can help to interpret the meaning of enquiries and understand investor's needs.

As a result of the diverse perceptions within the networks, tensions occurred between actors during the process of interactions. It is argued that the problems of managing effective networking does not come from a variety of interest and objectives of actors, but also relates to the perceptions of the situation of actors involved in the networks (Termeer and Koppenjan, 1997; Van Twist and Termeer, 1991). Innovation actors define their own roles according to their own perceptions of the environment surround them, which leads to their own definition of the problem. Thus the actions or solutions are driven by their own perceptions of problem rather than a shared solution. Only when the embedded social process of perception is better understood can strategies be developed appropriately to influence the process of interactions and achieve purpose of networking.

### **5.3.5 Summary**

Section 5.3 presented the operational practices involved in inward investment networking. It started by examining the meaning and content of inward investment

tasks in order to identify detailed activities conducted by managers during day-to-day operation. It has been observed that the working norms of the teams are regarded as informal, supportive and equal relationships. The nature of inward investment tasks were described as both proactive and reactive. It has also been identified that the nature of networking tasks tend to have an effect on the partnership relations in terms of communication and information exchange, in particular the invisible factors embedded in different organizational, institutional and cultural context are likely to create misunderstanding and communication problems during the process of networking. In addition, face-to-face communication is regarded as an important means of information exchange mechanisms during networking as it helps to enhance shared understanding on the intangible territory within the team members. Finally, it is observed that the roles performed by innovation actors are perceived differently due to actors coming from different context are driven by different objectives and interests. The findings from pilot study indicate that managing the conflicts within innovation networks needs to understand the fundamental differences of the mentalities between network partners during the process of interactions. The next section will focus on discussing the implications of these research findings.

## **5.4 Implications of Findings**

Attracting inward investment has been traditionally seen as an important strategy for developing regional economy. In the era of knowledge economy where continuous developing new knowledge and sustainable competitive advantages become the key agenda for firms, inward investment as a standalone method of regeneration, seems to be outmoded although it still plays an important role in promoting the region to the international market. Observations from the pilot study shows that one of the important reasons for the increasing difficulties facing the inward investment team is 'how to present the world about the strengths of the region', i.e. the inward investment managers will have to demonstrate clearly what the region can offer to potential investors, how good the infrastructure is, what are the key research expertise who can assist firms in conducting R&D, what are the local firm support in creating clusters of support in certain sector etc, which are essential for global investors to make the decision to the region.

Findings from the pilot study clearly suggest that in order to perform the innovation networking tasks effectively, a number of aspects need to be taken into consideration.

### **5.4.1 Information Configuration**

It is pointed out that the ability for generating innovation on one hand relies on the amount of information that actor is able to receive from the context in which they are operating. On the other hand, it is associated with the abilities of innovation actors to evaluate and assess the information that is useful for knowledge creation. (Newell et al., 2002)

Interview shows that an important aspect of inward investment activities in supporting innovation and economic development in the region is the ability of information processing. In order to promote the region and attract high-tech company from the world, managers perform networking tasks need to process both generic information about the region and specific enquiry related to certain sector and technology. In addition, dealing with the mounting information also needs certain format and information system support so that enquiry and information can be processed and followed up.

What emerged from the networking tasks is the significant challenge of information configuration. The meaning of information configuration is in twofold. First, how IIT identify, access and collect useful information about regional strengths including technological development, research expertise and infrastructure support in order to present high quality information to potential investors; Second, how IIT interpret information from potential investors and pass on to SRP for them to respond effectively. The ability to manage these challenges point to the needs for IIT to develop extensive knowledge networks in the region so that they understand 'what is happening in the region'. In the meanwhile, in order to interpret the investment enquiry, the IIT also needs to have in-depth knowledge and terminologies used in certain technology sectors.

In addition, although the purpose of IIT is to provide one-stop shop to potential investors outside the region, the changing global market and different types of investors demand different information and knowledge about what the region can offer. This requires the IIT continuously update their knowledge networks and maintain contact with other innovation actors in the region so that they can provide quality information to meet the diverse needs of potential clients. Charles (2004, higher education and business conference) pointed out that managing innovation networks require the actors to understand both direct and indirect knowledge base in the region. The direct knowledge base refers to public research institutions, such as universities as knowledge institutions. The indirect knowledge base refers to the groups of talent individuals embedded in informal and social networks. Despite of formal or informal institutional arrangements between RDA and other regional partner, maintaining individual contacts within the innovation networks is not easy due to various internal and external organizational change, because building knowledge networks with key information contact needs time for interactions so that trust relationships can be established.

The implication of configuring information during inward investment networking is the recognition for IIT to develop the ability of managing dynamic changes involved in networking in order to achieve the inward investment objectives.

### **5.4.2 Managing Dynamic Changes**

Change involved in managing inward investment networks is manifest from a number of perspectives: organizational, operational and individual.

Significant concerns were raised during interview with regard to the impact of continuous reorganization within the RDA. The SRP pointed out that they have to work with different people every a couple of years or sometimes every six months. Interview with SRP managers shows that the main issue with reorganization is not only the personnel change, but also the culture, internal communication system and power change. The key contact for SRP managers constantly changes, which to the great extent damaged the network relations and motivations of SRP in terms of participating in networking activities. This is also confirmed by IIT that significant changes within organization has affected on the morale of staff and the managers were worried about their jobs as they have to reapply for their existing position as a result of restructuring.

Although it is mentioned by IIT that the aim of the reorganization is to allow strategy works closely with delivery and implementation team. Beer et.al (1990) argues that understanding the necessity to change doesn't necessarily mean the understanding on what it takes to bring it about. It is clear in the case study that the consequences and impact of the change on external confusion and frustration have been under estimated if not totally undermined. It is argued that the change initiative from the top needs to take into considerations of the diversity and dynamics at bottom level in order to ensure the successful implementation of the strategies (Pettigrew A.M., 1990).

Under the pressure of the fast changing global market, the IIT has to adopt a flexible strategy and make quick decisions in order to catch emerging opportunities during the process of networking. Change is not something that can be planned. It requires actor respond in the timely manner and appropriate way so that opportunities are not gone away. In order to respond effectively to the investment enquires, IIT needs to collect various sources of information in a short time scales. The key issue is that these information and knowledge sometimes are not readily available and it takes time for IIT to collect from the networking partners including SRPs. However the SRP has

different working style and strategies to attract inward investment to the sub-regions. Therefore tensions occurred between IIT and SRPs when the IIT asked for information from SRP within a short time scales. In addition, due to the uncertainty of the investment market, not all information provided to potential investors can receive response, which makes it difficult for IIT to give SRP meaningful feedback for follow up actions. This has reinforced the tension and misunderstanding between the team members during the process of networking. As one of the SRP manger pointed out that *'we asked about the feedback of these enquiries that we received from them (IIT), but we don't have much information about it. I suspect that because of constantly restructuring that happening within RDA, people moving around and there seems to be little consistency on who is responsible for the enquiry'*. (SRP OM4)

It is argued that managing the pressure of change at the operational level requires innovation actors develop social and 'soft' project management skills ((Buchanan D. and Boddy D., 1992; McLoughlin I. P. and Jackson P., 1999) in order to develop mutual understanding on the different nature of working practice and context. The need for enhancing mutual understanding has been recognized by the mangers from SRP and IIT in terms of organizing frequent meetings and know more about the internal operation systems between the organizations and as well as the strategic priorities for inward investment.

Although many change theories emphasizes the impact of culture change, it is pointed out that successful change efforts focus on the work itself, not on abstractions like 'participation' or 'culture', in fact individual behaviour is powerfully shaped by the organizational roles that people play (Beer et.al, 1990). It is evident from the case that when team members from IIT and SRP have close interactions at individual level, more understanding is established on the problems and issues related to investment enquiry. Thus team members are likely to change practice to adapt the new situation.

#### **5.4.3 Coordination Mechanisms**

Research finding shows that the mechanisms of coordinating innovation networks are loose, democratic and equal under the partnership agreement. Here 'equal' means that as the representative of the region, therefore IIT managers have to maintain its neutral position to all SRP and cannot consider one SRP is important than the other when



introducing the regional situation to potential investors.

Working in partnership is one of the key features of coordinating policy implementation in the public sector in the UK. As both SRP SM and other SMs from regional business support indicate that partnerships is a mutual dependent relationships between organizations. *'we are equal, friendly and supportive to each other, but not in the hierarchical sense'*, as IIT SM commented.

Many theories on networking coordination emphasize social mechanisms of control (Gossling T., 2004, Lane Christel and Bachmann Reinhard, 1998, Nooteboom, 1999) such as interactions through informal networks and building up trust relations. The findings from the pilot study clearly shows that maintaining inter-personal relations is critical as part of the process of building up knowledge networks for innovation. Interactions at individual levels are described as friendly and flexible. *'It's very easy to pick up the phone to talk with them individually, they are all good people, we have shared goals and we are trying to do the same sort of job.'* (IIT OM1).

As an important social mechanism of coordination during networking, face-to-face interaction in facilitating trust and relationships is addressed as crucial by all interviewees. Trevino et al. (1987) found that face to face interaction was preferred for difficult, ambiguous communications because of its capacity for rapid feedback and multiple cues. Symbolic reasons were also given for choosing face to face interaction, suggesting that additional cues of caring, building teamwork, showing trust and informality were important. It is clearly evident that effectively processing investment enquiries require network managers have insights on the needs of investors. Therefore face to face interaction can help to reduce ambiguous and clarify misunderstanding on the key issue of concerns. In addition, Siltkin and Roth (1993) indicate that trusting relationships are rooted in congruence between the individual's values and the values of the organizations.

However the perceived good inter-personal relations and common goal doesn't imply less effort in coordination and control on networking tasks. The 'loose and friendly' nature of coordination mechanisms seem to be contradict to the increasing demand for 'tasks-oriented' and 'project-focused' business culture for managers working in the

public sectors. Particularly, when IIT SM described themselves as '*public entrepreneurs*', there is clear implications on the needs for creating the appropriate coordination mechanisms which ensure tasks are done and problem are solved in an effectively and efficient manner.

According to research interviews, one of significant criticisms on the process of partnerships is the separation between strategy and implementation. Despite the formal established partnership relations between SRP and IIT, both SRP and IIT have acknowledged the problems of communication at operational level were not paid enough attention by strategic level due to different mentality and strategies adopted by the IIT and SRPs.

Another coordination mechanism is related to the role of strategic leadership in the collaborative environment within partnerships. It is argued that effectiveness of networking is determined by the capacity of actors to demonstrate leadership in interactions by devising new options, speaking out for them to their organizations and in addition by succeeding in getting their organization to keep to the agreed procedures (Kickert and Koppenjan, 1997). In another words, the leader in the partnerships is to provide support to other actors in terms of resources, procedures and arrangement so that actors can perform efficiently.

The pilot study shows that IIT is perceived as leader of the networks and acts as information 'filter' and 'interpreter' for the rest team members. This means that the IIT needs to support the other team members through providing 'meaningful feedback' as well as 'quality information', which are viewed as essential for maintaining the proximity of network relationships by SRPs. Performing the role of leadership effectively needs continuous interactions with other team members and create a shared understanding on their needs and how to support with each other. However because the nature of partnerships between actors is loose and flexible, there is lack of commitment for mutual inter-dependent relations between the team members to make sure things are done. Consequently, SRP felt not being involved in the process and lack of support by the network leaders. Therefore a certain degree of alienation occurred in the network.

Evidence collected from interviews suggests that in order to lead within the network environment, leaders need to maintain supportive relationships with other actors through continuous interactions and creating an open environment of communication so that both explicit and tacit information can be exchanged. Network participants can be ensured about 'what is happening' and 'what will happen'. Once meanings are clarified, commitment will flow and goals can be infused into mission. Appreciation the importance of 'knowing' in order to support network activities points to the need of learning. As Cooke (1998) argues that if knowledge is regarded as the ultimate purpose, learning is the process that leads to the creation of new knowledge. This leads to the aspect of learning that is embedded in all aspects of network implementation.

#### **5.4.3 Issues of learning**

The process of learning during inward investment networking is manifested at three levels: individual, organizational and cross-cultural learning. It is argued that when innovation actors work across organizational and institutional boundaries, cultural tolerance and empathy is a basic condition for communicative openness and learning (Boutellier R., 1998). Melding different cultures together when working together is also a key learning for actors working in the networking context across boundaries (Pauleen D.J. and Yoong P., 2001).

At the individual level, it is evident that individual learning is supported by proximate relations developed through face to face interactions. When there is lack of face-to-face interaction between the team members, there is more complains about break of communication and lack of shared understanding. On the contrary, the team relationships appear to be proximate when there is more face-to-face interaction. At the organizational level, it seems that different organizational and operational context as well as continuous restructuring and changes in the global market hindered the communication between team members thereby affect the result of learning. With regard to the cross-cultural learning, it is noted that the investment teams are dealing with the international market, therefore enhancing knowledge on business culture and practices are essential to interpret the meaning of enquires generated from certain culture and identify the needs of potential clients.

In order to perform networking effectively, it is necessary to create a learning culture, as indicated by Macher (1992), a learning culture is one where people were creative in all their relationships and experiences. Managers need to be encouraged and motivated to take risks and try out new ideas. It should be noted that creating a learning culture requires support and effort from all actors involved in the innovation networks. The strategy for attracting inward investment cannot be achieved by IIT alone, rather it requires collective actions and interactive networks of a wide range of innovation actors within the region.

## **5.5 Conclusion**

The purpose of the pilot study is to develop an initial understanding on the process and content of innovation networking in the regional context. As part of the regional economic development strategy, inward investment has been an important function for linking the region to the global market by bringing in new technologies, investment and R&D firms into the region so that the local firms, particularly SMEs (Small and Medium Size Enterprises) can benefit from new knowledge creation opportunities by establishing collaboration or joint ventures with external firms. Although the pilot study forms a small part of the overall research design, the study on the inward investment networking in the regional context provides a heuristic narrative of the key processes and issues involved in developing the regional economic development and innovation. The summary of the key implications is presented as below:

First of all, innovation networking to a certain degree depends on the ability of information processing. The process of inward investment networking involves not only generic information about the region in general, but also specific sector related information. Providing quality information to potential investors in an effective and efficient manner is crucial for the success of the inward investment strategy. The significant challenges facing network managers are how to identify and access relevant information and knowledge, more importantly, how to interpret the information in a meaningful way so that decisions can be made and appropriate actions can be taken.

Secondly, despite the structural facilitation created through partnership agreement and

perceived common goals among network partners, the delivery of inward investment strategy is far more complicated due to dynamic interests and objectives pursued by other actors. Part of the reasons as indicated by the interviewees, is due to lack of support and interactions from the strategic level to create an open environment that is conducive to information and knowledge sharing between different actors. Thus how institutional arrangement at the strategic level and the leaders of partnership organizations facilitate implementation and network operation is important.

Thirdly, changes involved in innovation networks are from both internal and external. Although reorganization is seen as a means of improving existing operation and seeking new development, misunderstanding and confusions occurred when the process of restructuring is not clearly understood by external working partners. Managing change is also derived from the pressure of responding to the dynamic environment and global market. Coping with dynamic changes not only require actors equipped with generic knowledge about where to seek information, but also require technical knowledge related to the innovation content so that the needs of potential investors can be better understood.

Finally, mobilizing collective actions for effective networking needs interactive learning at various levels of operations. It is identified that individual interactions based on face-to-face meetings plays an important role in mobilizing actions and reduce ambiguities involved in network communication. In addition, learning requires interactions between what is known based on the experiences and what's new in terms of new information. Therefore it is important for policy makers to create a learning culture that facilitates effective information and knowledge sharing between innovation actors.

The significance of the issues emerged from the pilot study will be further explored and examined through broader networks of interactions for enhancing innovation capacities and developing knowledge economy in the regional context.

# **Chapter 6 Presentation of the Main Study**

## **6.1 Introduction**

The success of policy cannot be achieved without effective implementation. Although the overall policy networks presented in Chapter 4 provides the aspirations and strategic intention for the region to become the knowledge-based region, evidence collected from the pilot study has shed lights on the difficulties and challenges associated with building up effective networking relationships across organizational boundaries at the regional level. The major implication arising from the pilot study is how the strategic intentions can be translated into practice and how resources and effort can be dedicated to the interactive networking to achieve the expected outcome. It is against this aspect that this chapter presents overall picture and the research data of the main study undertaken in the North East of England with a particular focus on the implementation of SfS innovation programme, i.e. how Triple Helix networks are implemented via the new created CoEs to engage with university and industry in the region and the key networking challenges facing innovation actors within the Triple helix networks.

## **6.2 Building Network Relations within the Triple Helix**

### **6.2.1 CoEs and Industry Relations**

The nature of CoEs and their operational strategies are vary, depending on the technology areas each centre decides to focus on. The operational strategies are at different developmental stages, either based on existing industry strength, or start from the beginning to map out the information and build up the technology development strategy. Despite the official definitions and functions given by the SfS policy document, the CoEs perceive themselves as private companies which have both private interests and public interests. Each centre has its own market to address its business strategy. The private nature of the CoEs decides that they need to think about their overheads and costs as well as promoting public objectives.

### 6.2.1.1 Debate about the Status and Roles of CoEs

Despite of the public objectives given to the CoEs, research finding suggests that there seems to be a certain degree of confusion among the teams as to what kind of organizations they are, which has impact on their rules of operations.

For instance, the CENAMPS SM pointed out that: *'since we were created by the Regional Development Agency, and funded by European and regional development fund, which makes us a more public organization, so I guess we are public sector really'. Similar view was expressed by Codework and CELS SM who commented that 'we are all for public good, public service.'*

However, there are also different opinions in terms of the nature of CoEs. Given that all CoEs have the tasks of being self-sustainable within certain number of years, some managers regarded self-sustainability through commercialization as the priority of the innovation tasks when they were asked to rate on their key objectives. The NaREC OM said: *'CoEs are just like other organization, we don't have any special position when applying from government funding, we were just treated as other organizations by the regional development agency. We are commercial organization with high level project managers who have worked across the world, and bring different ideas together to make technology'*.

*'Neither pure public, nor pure private, we are in the middle'* is the general opinion from the majority of the interviewees. Among the 10 interviews with operations managers within five CoEs, 8 managers confirmed that because the CoEs were funded by the government, they have public duties and the right to intervene innovation policy. Therefore they regarded themselves as public sector. The other 2 operations managers though admitted the public nature to a certain degree, they pointed out that the way CoEs were set up and nature of their business which is companies limited by Guarantee, defines that they need to operate in private terms.

In terms of the role played by CoEs, the CoEs perceive themselves as specialized organizations with targeted technology to catalyze and also a knowledge broker.

The CPI SM pointed out that: 'we are not normal support organizations, our strength is that we understand the technology better, we are specialize organizations to catalyze. Similar point was expressed by NaREC SM: 'We act as catalyst because we know people well and know what they do well. Essentially we play a knowledge broker role in the region.'

The perceived nature and roles by CoEs managers as 'catalyst' or 'broker' surely fit into the concept of knowledge-based innovation that is focused on the ability of tapping, utilizing and mobilizing diverse ideas from a variety innovation actors in the networks (Kickert and Koppenjan, 1997).

#### **6.2.1.2 Developing Operational Strategies**

Interviews with operational managers from CoEs and their collaborative partners during innovation networks suggest that although all CoEs have both public and private objectives to achieve, the operational strategies vary due to different target technology areas.

*CENAMPS* has about 10 members of full time staff who deal with many grounds and different projects. The organization is structured around projects. Projects are not perceived as results, but as a mean to deliver the knowledge economy, i.e. creating jobs and strengthen supply chain within the region. The operational strategies are approached from two perspectives: proactive and reactive. The proactive strategy focuses on two or three technology areas which are identified to be potential strength in the next decade and then build up support for those areas and companies. The reactive approach is to respond to companies enquires on technology areas. The CoE team will analyze and investigate on what the area can bring about and how to strength the position future. The performance of the team is evaluated through the customer's feedback. Because people are too busy dealing with their own projects, it is evident that sharing information seems to be an issue within the team. Sharing information is also difficult due to the nature of the project is different. Having recognized this issue, the team was trying to rely on information technology to share information through setting up intranet within the centre.

*NaREC* operates in two layers of innovation processes. One is to engage with the



knowledge transfer networks associated with university and industry in the region. The other is to deliver the policy outlined in the government energy white paper. This involves national policy networks and energy related associations because energy sector is highly influenced by the government policy. In addition, the energy market is not there already, it needs to be developed and shaped by those who are involved in the networking process. The operational strategy for NaREC is very capital extensive due to the nature of the energy sector. Some stage costs about half million pounds from research development, prototype building processes towards final commercial products. According to the NaREC manager, the CoE is to convert idea into organization that can create product and services and building networks at various level is essential for achieving its operational strategies. The operational strategy of NaREC is achieved through making investment through collaborating with local companies, prioritizing different stages of development activities and be flexible on emerging opportunities. It is hoped that over time networks can be built up to shape the research and development of the energy sector.

*Codeworks* has about 30 members of staff working in three main areas of business within the centre: corporate finance, innovation and support for digital clusters. The key objective for Codeworks is to pull deep market knowledge, industry expertise into university to inform research agenda. The support for digital clusters is through the creation of a Trade Association – Codeworks Connect, which has a membership of around 200 active digital companies in the North East region. The main activities for Codeworks Connect include assisting local companies on accessing to finance, marketing & business development, creating networks and skills development. The advisory board of Connects involves senior members from the regional university, big corporations in digital sector, business support agencies, government office, universities as well as the Codeworks. The purpose is to build up support and networks from the key stakeholders involved in the innovation system. The corporate finance involves helping regional companies access to NStar funds to develop new technology or product. Finally the innovation activities cover a range of projects including analyzing regional strengths against global market in terms of accessibility, web services, games, computing and Spin-out opportunities. What's more, Codeworks also operates projects funded by the government to take innovative digital research and transmission into SMEs in the region. It is intended that through the development

of the project networks, the commercial objectives of Codeworks can be achieved in the long-term.

*CPI* operates in a different way from other centres according to the CoE manager due to the mature and established industry base that has been developed in the region. Whilst other centres are concentrating to bring knowledge from the university to industry to improve the knowledge base in the region, *CPI* acts as a brokerage to pull the knowledge which they believe are from the industry, and contact university to further develop the knowledge. The centre is structured in project teams. The project networks are based on the government funded projects with the collaboration between universities and industries. In terms of operation, *CPI* develops three levels of operational strategies, (1) identifying and talking to potential business partners to pursue collective funding; (2) setting up collaboration between university and industry; (3) managing and coordinating projects through networking; *CPI* sits in the centre to allocate interests, resources and coordinate collective actions from partners. Projects are managed through the steering groups consist the project operation team, funding organizations and business partners.

*CELS* operates through supporting the academic community networks as well as individual spin-off companies because that the knowledge of life science to the great extend still remain within the labs in the universities. Therefore supporting the networking of academics communities is regarded as the important strategy of knowledge sharing between academics. *CELS* has extensive database-backed knowledge of the Healthcare, Life Science and Biotechnology organisations in North East England and is continually involved in spin-out, start-up and business expansion activities. One of the projects is bio-networks which is the academic community networks funded by *CELS* and organized by the academics within the university who act as event organizer and liaison manager between the academic communities and *CELS*.

### **6.2.1.3 Building up Industrial Networks**

As it is argued that activation of innovation networks involves three important elements: to decide which link to develop, what information is needed through the links and creating rules of interactions ((Friend J.K. and Power J.M. and Yewlett

C.J.L., 1974 ; Friend J.K. and Power J.M. and Yewlett C.J.L., 1974).

Data collected from main study indicate that the innovation networks developed by CoEs are in line with the operational strategy and the nature of the technology each centre is involved. The operations of innovation networks also are developed at regional, national and international levels. For instance, within Codeworks, the organizational networks include all members developed through the electronic project networks; the inward investment teams from the Regional Development Agency; other business support organizations such as business link, Chambers of Commerce; Trade and Investment; Technology Transfer Office, management teams and individual researchers within the university and international contacts.

Research interviews and observation also identified that the innovation networks were built up through various means and channels. For instance, by appointing executive or non-executive members into the advisory board, these people have extensive networks in certain technology areas or sectors and therefore will be able to influence government in policy making. The networks can also be set up via the establishment of the network association (e.g. Codeworks connect) or formal R&D networks (NaREC's R&D Matrix) to attract interests of the target companies or investors. Joining policy networks as an institutional member is also a way of accessing information and key contact within the sector or technology areas. In addition, organizing various events or forum around different themes is also perceived as an effective way of building up knowledge networks. The events can be general or specific technology areas. The general event aims for companies to share their experiences of developing their business in the technology sector. The specific event can be a follow up meeting for those who had initial interests to further discussions and develop potential projects. The location of the events can be either within the region, or can be outside the region in another country such as international exhibition. Such event will help participants to get out of the normal environment and bring them to an international context so that they can interact with each other and develop personal relationships, which is fundamental for building up trust-based business relationships.

It is evident that during the process of developing innovation networks, the role of

personal contacts in building up knowledge network is perceived as important. At operational level, CoE operational managers approach individual companies or university academics through face to face meeting and presentations trying to identify the areas of technology developed by the university or the needs of the company. For instance, the CELs OM pointed out:

*'Knowledge networking requires time to contact people and know people, the investment in principle is about evaluate people who are capable of exploiting and exploring technology. If I got a great idea and I want people to invest in it, but you don't know whom I am, and we have to go to go through the process of knowing each other before we start doing something, this will waste a lot of time. That's why we try to create chance for people with specific interests meeting each others because personal contact is the most important in the process of innovation'.*

The SM from regional support organization further emphasized that 'by creating mental networks, we get to know where the expertise are in this region and will be able to better inform business on relevant resources and expertise for innovation.

Linking to the recognition of personal knowledge in creating knowledge map, the importance of face-to-face interaction is also highlighted by a SM from the regional firm. It is commented that *'You really, really got to network and meet a rang of people. For academics, you can run research groups, you can do research papers, but a lot time, you don't work with them, it is kind of separate.....In business, if you don't network, you don't go anywhere.'*

#### **6.2.1.4 Maintaining Networks**

Establishing knowledge networks is only a starting point, the activation of innovation networks also requires energy developed on maintaining the relationships via effective communication between relevant actors at various levels. Both observations and interview data manifest that there are different levels of communications developed by CoEs including marketing level, organizational and institutional level, strategic management level, operational level and interpersonal level.

The marketing level of communication aims to promote the role of CoEs through

various public sources, website, press release, news letters, and public events and raise awareness of the technology that the centre is promoting. The organizational and institutional level of communication is through the distribution of the policy document and it sometimes involves the annual meeting of the senior members of the key organizations to discuss relevant policies. The interactions between strategy management are perceived as important for implementing the CoEs strategy. For example, the CEO (Chief Executive Officer) from the CoEs meet on the regular basis with the Sfs management team and SIC to discuss the strategic development of the Centres and project progress that have been initiated. It is usually through the strategic management meeting between the CEOs that feedback on the CoEs performance are received from their key stakeholders and suggestions are made for considering new development for the CoEs operations. The next level of communication is at the project-based within the business development teams. Project managers interact with managers from other organizations or centres on specific technology issues. Finally, depending on the experiences of individual and the technology area, personal networks are often used to identify the key contact and access to relevant information within the organization.

According to the senior manager from one of the regional firms, *'Networking is eventually about seeking information that can be used to develop new project related to the technology or the sector that the business is involved.'* During the process of research, it is clearly evident that information sought by innovation actors through networking not only contains technological information, but also personal related information, such as what activities those innovative academics are involved, what new research has been developed as well as market and industry trends on new technology development. In addition to project related information, information on the organizational structure and layers of management are also perceived as important by managers working in RDA, CoEs and other regional business support organizations. Therefore it is not surprising that many efforts were made by managers from the support organization to build up information database and maintain links with key researchers in the relevant technology areas and businesses in the region. Despite of the significance of organizational and personal related information, obtaining such information and maintaining contacts do not appear to be easy. Business managers often face the problem of losing links and contacts. As the OM

from the business support organization stressed:

*'We spent a lot time building on relationships with certain contact within the organization. However the person left the department due to organizational restructure and all our effort has been wasted and we have to start all over again explaining what we are trying to do'.*

Though the significance of activating innovation networks and maintaining regular contact at various levels of operation can not be ignored, the key challenges facing innovation actors seem to come from complex institutional relationships and perceived roles of innovation actors during the process of implementing innovation tasks.

#### **6.2.1.5 Selective Approach**

Although the SfS programme broadly identified the key actors include the regional universities, industries and new created organizations CoEs to facilitate interactions between university-industries, the strategic intention does not seem to be interpreted in the same way by the wide arrange of stakeholders across the region. Interview shows that some business sectors felt being left aside by not being seen as the strengths in the region, therefore they were not prioritized when trying to engage with CoEs and apply for funding to support business growth. Successful selection of network participants depends on the correct assessment on the right actors. Evidence suggest that whilst CoEs were created to support the development of the five technology areas, the diversity and dynamic activities involved in these technologies make it difficult to identify and prioritize the specific technologies that will create regional competitive advantages in the global market. Therefore the decisions on selecting specific technology areas and business development depend on the knowledge and expertise of individual CoE which are staffed by global renowned figures with rich international experiences in technology exploitation and commercialization. However a number of interviewees raised concerns on whether the external experiences can be adapted into the regional context, and the decisions made by the Chief Executives are accountable and appreciated by other stakeholders in the region. In addition, the assessment of the specific technology areas for financial support is based on the CoE's interpretation of the market trends and whether the technology is valid for commercialization (although the companies may have different

views on the market). The refuse of some business funding application suggests that the CoEs are certainly having their own *selective and targeted approach* of choosing actors into their innovation networks, rather than being a generic network support organization for all the businesses involved in the technology areas.

## **6.2.2 CoEs and University Relations**

### **6.2.2.1 Project-based Relations**

Within the innovation networks, the interactions and relationships between the CoEs and university were described as project-based rather than through institutional links.

The CoEs insisted that the relationships with university and industries are project based, in particular it is emphasized by the CoEs managers that they are dealing with projects, not institutions. The strategies adopted by CoEs that focus on building up project-based relationships from bottom-up with individual research does bring to fruition of a number of key objectives set by CoEs.

It has also been noted that the *build-up of project relationships* does not start from a clearly defined project at the beginning. In fact, the relationships often start by vague ideas or general interest from the CoEs, business managers and academics. The CoEs usually sit in the middle talking to both sides and collect specific interests, information on potential technology that could be commercialized and who are the experts researching in the technology development. Information is collected from various sources and personal interactions through various networking events. Through the interactive process, the ideas or concepts are developed into a project based on the common interests of academics and industries. Then the CoEs will perform their project management role to further define the key elements of the project, allocate resources, monitoring progress, negotiating with academics and companies to agreement on technical details, product development and commercial operations.

### **6.2.2.2 The Perceived Roles between CoEs and University**

The nature of the relationships between CoEs and University is derived from the perceived roles and function of CoEs by the regional universities. From the university perspective, the CoEs were created under the assumption of that there is knowledge gap between university and industry which has been perceived as the main barrier of

innovation in the region. Therefore it is important that the new organizational structure was created in order to bridge the gap. It is assumed that information can flow between university and industry through the facilitation of the new established organizations. However research finding shows the operational practice of facilitation is far more complex than the linear model of innovation, and is reflected through the dynamic relationships at different levels of innovation networks.

*'The effective knowledge transfer lies in the nature of the relationships. However when CoEs were set up, there is no clear defined relationships between the university and CoEs. There is no formal agreement on what is actually agreed. Therefore the interactions have to be conducted carefully'. (University SM)*

From CoEs point of view, the university is perceived as traditional education provider with bureaucratic structure and struggling with the business driven culture in the region. Therefore the CoEs felt there is a need to support university to become as commercially open as possible they could. In the meanwhile the CoEs wanted to keep the relationships as natural and comfortable for the mutual benefit of both sides and did not want to force university to become something that they are not comfortable to be. Managers from the government agency, SfS team and CoEs emphasized the importance of *'shared activities'* for developing knowledge-based innovation. It was felt that networks can be created to share information and resources, the collaboration with university should not be perceived as a forced relationship, rather it should be based on the recognition of mutual benefit and driven by the willingness of cooperation and collaboration for innovation.

However the views from the CoEs and government perspective did not seem to reflect what university had been sought. As the role of university in economic growth has been increasingly addressed by academic literature and government policy, senior management from the university takes the view that university should be seen at the centre of the knowledge-based innovation and playing a leading role in the process of innovation. As it was pointed out by the university OM that:

*'We are in the transition period from traditional education providers towards new university that is aware of the business opportunities and certainly see the benefit of technology transfer and commercial activities for the university in terms of further*



*research and publication opportunities as well as income generation ' (University OM)*

Data collected from university managers and academic researchers also indicate that the university has been actively promoting commercialization and technology transfer activities through the establishment of knowledge transfer projects and related enterprise centres to encourage academic staff engage with business. These activities at the operational level helped to generate and develop mutual understanding between academics and industries in the region.

Although organizational arrangement is argued as important for providing the basis of operation and implementation of networking ((Klijn E.-H. and Teisman G.R., 1997), data collected from interviews suggests that lack of formal arrangement at institutional level did not seem to prevent on-going interactions between individual managers from CoEs and the academic researchers working on relevant technology transfer projects. As a matter of fact, the CoEs managers received a lot positive feedback from the university researchers in terms of providing guidance and advice in certain technology transfer and commercialization projects conducted by the professors within the university. It is evident that good interpersonal relationships were established between CoEs managers and university researchers as one of the professors from the university described such relations as *'professional and friendly'*.

The impact from the institutional and strategic level was less concerned when managers from the CoEs worked with individual university professors on specific commercialization projects. The main reason as indicated by the university researchers that university academics made effort in developing Intellectual Property (IP) and would like to see the generalization of its results through commercialization. The CoEs managers were able to provide relevant information and business expertise on how to commercialize IP and identify the market for the development of the particular product. It is clear that the cooperative relationships were generated from the willingness and desire from innovation actors to engage in knowledge creation activities. This evidence has clearly supported Thursby et.al (2000) in arguing that the increased willingness of professors to patent their inventions.

### 6.2.2.3 Multi-level Interactions and Diversified Activities

The processes of interaction with university were conducted at different levels including senior management team, academic schools and department as well as individual academic researchers. The relationships established between the CoEs and universities were either through informal links with schools and individual researchers or formal contact with senior management teams within the university. Although the CoEs adopted different approaching strategies, observations from research seem to indicate it was more effective to establish relationships at operational level than at the strategic level. The reason, as illustrated by one CoE OM that:

*'Because the university is quite big, and there are so many academics, research centres etc, we can approach senior management team, however it would be impossible for the senior people to know everything happened in the university, we are still going to be directed to another person. Therefore it is easier for use to discuss details with individual professors on specific innovation project. '*

As a result, personal networks were perceived as more important than institutional links especially managers had to deal with bureaucratic structure and layers of management when engaging with institutions. During the interview, it was identified that various means of interactions were developed by CoEs in order to engage with university academics and facilitate the process of knowledge creation and diffusion. These include supporting various regional events, organizing workshops within the university, embedding industrial engineers within the university and facilitating funding applications from university academics.

Engaging with academic community by supporting various events in the region is one of the important strategies adopted by the CoEs in order to bring academic and industrialists together to establish information networks, identify what's going on in the relevant field of technology and share information on the latest development of technology transfer and relevant issues such as early stage product development in the global market. Most of the network events were organized free of charge in order to attract more academics and regional firms. It was hoped that through the networking event, information could be shared between university academics and regional firms so that collaboration on research or technology commercialization projects could be

created and developed. As the supporter of the events, CoEs would receive the report or meeting minutes from the events organizer who was usually the university academics or managers from regional business support organizations to follow up the potential projects developed from networking events. The CoEs managers would also discuss with the events organizer in terms of maintaining networks with event participants and planning for the next stage of development to support more innovation activities.

Doing workshop or presentation within the university is identified as another way of engaging with university academics. Such events are usually organized through the university enterprise centres or business development office which is keen to develop business relations with regional firms for generating studentships and industrial placement opportunities. The content of these workshops was usually related to the general information on how to transform an innovative idea into a new business, or new product and the key sources of funding available which is regarded as the key during the process of commercialization.

Embedding industrial engineers within the university is also an important strategy adopted by the CoEs in order to build up regional support for companies. By embedding industrial engineers within the university, practical experiences from industry were shared with university academics thus problems can be solved by creating new solutions.

Another important interactive process between CoE and University is through the funding application as one of the organizations Nstar, was created by the SfS as a venture capitalist that can provide funding support for early stage development of technology. The CoEs were involved the process of funding application as officially recognized sponsors within the region. The main funding application that the CoEs were involved is the approval concept fund which is designed to support early stage of technology development and university spin-offs. Therefore facilitating the application of 'approval concept' fund was regarded as one of the important tasks for CoEs during the process of interactions with university academics. For instance, managers from the CoEs get involved in early stage discussions about the ideas and concepts, helping with application procedures by explaining details of application

forms, advising on business plan, marketing research and financial projection etc., which are important criteria for the success of the funding application. Interview shows that through the close interactions, information was shared between CoEs managers and academics based on mutual understandings which then led to more cooperative working relations at operational level. The collaborative relationships were described as informal but professional as one academic described:

*'For me, formal relationships implies cold and difficult. Certainly my experiences with the CoEs managers are not cold. I use informal to describe the relationship, but it doesn't indicate in some way sloppy and it is certainly not the case. They are very professional and friendly'*

The assistance from CoEs were greatly appreciated by university academics in terms of providing professional support and advice on how to engage into the commercial world and deal with business. In addition, accessing a wider business networks at regional, national and international through the CoEs was also acknowledged as an important outcome of the interactions. As one professor from the university spin-off company explained that:

*'we are not business man, and we were not in business before. It came into a shock at the beginning because my mind is not commercial and I don't know what people would buy and why they don't. Although I developed the concept from my research, I do not have sufficient knowledge around the product, and how to position it in the market it etc. The CoEs helped me a lot to go through these things. '*

Evidence shows that the interactive process not only provided assistance for academics to obtain funding to commercialize their research, the process to some extent implicitly orientated the academic research towards the way that was intended by investors in line with the market needs. During the process of applying funding, the researchers had to continue revise their business plan and rethink about their concept and potential product in accordance with the market trends and customers. As highlighted by one of the university academics that:

*'.....they didn't tell us what to do. We were just told that the business plan is not*

*sufficient and interesting enough. We have to go back to revise our plan and do more marketing research. I can see from investors point of view that they would like to see growth whereas we were not thinking big enough at the beginning, ....at least we are now'.*

In terms of managing the process of interactions, regular communications were seen as essential for maintain good relationships with academics. CoEs managers drop in the university regularly to meet with academics regularly and discuss latest development on relevant innovation projects. Some CoEs managers even had an office space within the university so that they could spend more time in campus to maintain close interactions with research community and observe the academic and research development within the university. Among various means of communications, face-to-face meeting was perceived as the most useful and effective means of collecting information during the interactions although telephone was also used by CoE managers. Because it was easier to talk over the phone when exchange opinions was important to clarify complicated issues. Maintaining relationships through effective communications was regarded essential in developing innovation projects. As one of the CoEs manger put it:

*'Knowledge creation is all about people, it is about people who not only create the best ideas, but also those who drive the ideas. These good ideas would go to somewhere else if you don't have a strategy to retain good people. Therefore it is about working with university to identify these expertise and establish good relationships, give them support so that they can stay in this region to develop more innovative technology'.*

### **6.2.3 CoEs and Government Relations**

The fundamental purpose of the Strategy for Success initiative is to create the knowledge innovation system in the region through the promotion of collaborations between firms, universities, consultants and other agencies so that innovation through knowledge creation and knowledge sharing becomes a natural tendency in the region. The public nature of CoEs decides that the CoEs not only need to interact with industries and university, but also need to coordinate the relationships with other initiatives involved in SfS programme for sharing information, knowledge and other resources in public organizations. This section will present findings regarding how the

relationships between CoEs and other knowledge initiatives are coordinated in the networks. The implementation of the Sfs programme is coordinated by the Sfs programme team which is based in RDA in association with the Science and Industry Council as well as senior management of RDA.

#### **6.5.1.1 The Coordination Role of Sfs Team**

The Sfs team is a small programme team within RDA which aims for the successful delivery of the Sfs programme. The main role of Sfs team is to develop the Sfs programme in terms of policy, strategy and business plan. The delivery of the strategy and business plan is through the programme management role between CoEs and Nstar. The Sfs team needs to make sure all the elements of the initiatives are working together during the course of the programme delivery. The Sfs team also acts as the secretary for the SIC and interface between CoEs, SIC and RDA regarding the progress of the programme implementation.

Within the Sfs team, there is no formal structure as to who is responsible for which CoE and defining means of coordinating with the relationships with CoEs. One of the reasons is due to the size of the team is too small and there are not enough number of people to allocate for each centre. Therefore rather than having a formal structure of engaging with each centre, the team adopted the approach of project-based interaction. Although Sfs are working within the public sector, the team is mixed of people from different industries with different knowledge and skills. The team felt that their role is different from the traditional public sector in the sense that they are more flexible rather than working through the traditional bureaucratic rules and regulations. The way to capture the nature of their work is that:

*'we provide public sector consultancy and develop innovative ways to facilitate the programme delivery and it is the process of developing mutual understanding between the policy, strategy and the actual practice. Our culture is a kind of consultancy culture'. (Sfs SM)*

#### **6.5.1.2 Interactions between Sfs and CoEs**

The Sfs team manages the interactions with CoEs and other elements of the

programme through a number of ways.

### **Financial Control**

The SfS team monitors the financial output of CoEs against the funding objectives and how these objectives are met through the operation of CoEs. For instance, the number of projects that have been developed by CoEs, number of companies established for exploiting new technology and number of jobs created etc. The output needs to be quantifiable in order to justify the funding

### **Business Plan**

The SfS team also helped the initial set up the CoEs and engaged in appointing key staff within the Centre, communicating the policy document and strategic objectives, assisting the Centres to develop business plan and how they can be delivered.

### **Science & Innovation Policy**

As the secretary and interface between CoEs and SIC, the SfS team also provide guidance and advice to CoEs on the latest development of Science & Innovation Policy at regional, national and European level and how the new policy will impact on the innovation strategy and development new technology.

### **Project Management**

Finally, the SfS team also draws on their industrial experiences to provide suggestions on specific projects operated within the CoEs.

In addition the main activities of managing the programme delivery, the SfS are also keen to create opportunities for CoEs to work closely on joint projects. One of the reasons as indicated by the interviewee is because the technology areas that the Centres are working on are very much close with each other and there are a lot of common interests which can be shared between the Centres by sharing information and resources. In this sense, the SfS also act as liaison team between the CoEs and identify opportunities for joint projects.

The communications between the RDA, CoEs and SfS take place at different levels. There are strategic and policy level communication between the SIC and SfS based on

regular meetings among Executive Members. The project teams within CoEs also meet Sfs team to discuss projects and business plan. The communication at project levels is felt efficient due to that Sfs team is based in the same building with the CoEs team. In addition to project communication, Sfs team also held regular meetings with the financial directors in order to monitor the financial performance of the Centres.

#### **6.2.4 The Triple Helix networks within Sfs**

Despite the common strategic objectives for the CoEs to engage between university, government and industry, research interviews and observations indicate that in practice each centre develops its own way of engaging with other innovation actors in the targeted technology areas. Figure 6.1 – 6.5 illustrate different engagement mode of CoEs within the Triple Helix networks when implementing Sfs innovation programme. It should be noted that these modes of engagement are conceptual, which provide visual assistance for understanding the working mechanisms of CoEs inside the Triple Helix networks. However these modes of engagement have been established based upon the observations of the researcher and the qualitative data collected from interviews for the purpose of enhancing the understanding of the relationships described earlier in this Chapter.

Three key features of the Triple Helix relations have been identified from the mode of engagements of CoEs as follows:

Although the CoEs were and led by government innovation programme and coordinated through the Sfs team for knowledge creation, research data shows that the CoEs tend to engage more with university and industry than government. The broken line between CoEs and government indicate that there has been lack of work-related engagement between CoEs and government apart from public funding management via Sfs team. The figures also demonstrated that each centre adopted different strategies of engaging with universities and industry due to the nature of the technology development within the region. These include co-investment in the innovation project, developing joint research projects with universities and exploring and establishing international links with global research centres.

In general, the mode of engagement is manifested in three types of operational



strategies: industrial-oriented, research-oriented and industrial-research collaboration strategy. For instance, NaREC and CPI are working more towards industrial-oriented strategy since the energy and process sector are dominated and shaping by national policy and large capital investment from big corporations. Therefore the research agenda tends to be shaped by the requirements from industry. Whereas for technology involved in life science, which is based on lab research, the knowledge to the great extent remains unexplored in researchers' minds and needs to be developed and commercialized into actual products. Therefore CELs works more towards to academic communities within the university to foster knowledge transfer from academics into industry. Other CoEs such as Codeworks and CENAMPS adopt industrial-research collaboration strategy, and interact with both university and industry through extensive networking to identify opportunities for technology commercialization and support research base etc.

**The Engagement Mode: CENAMPS**

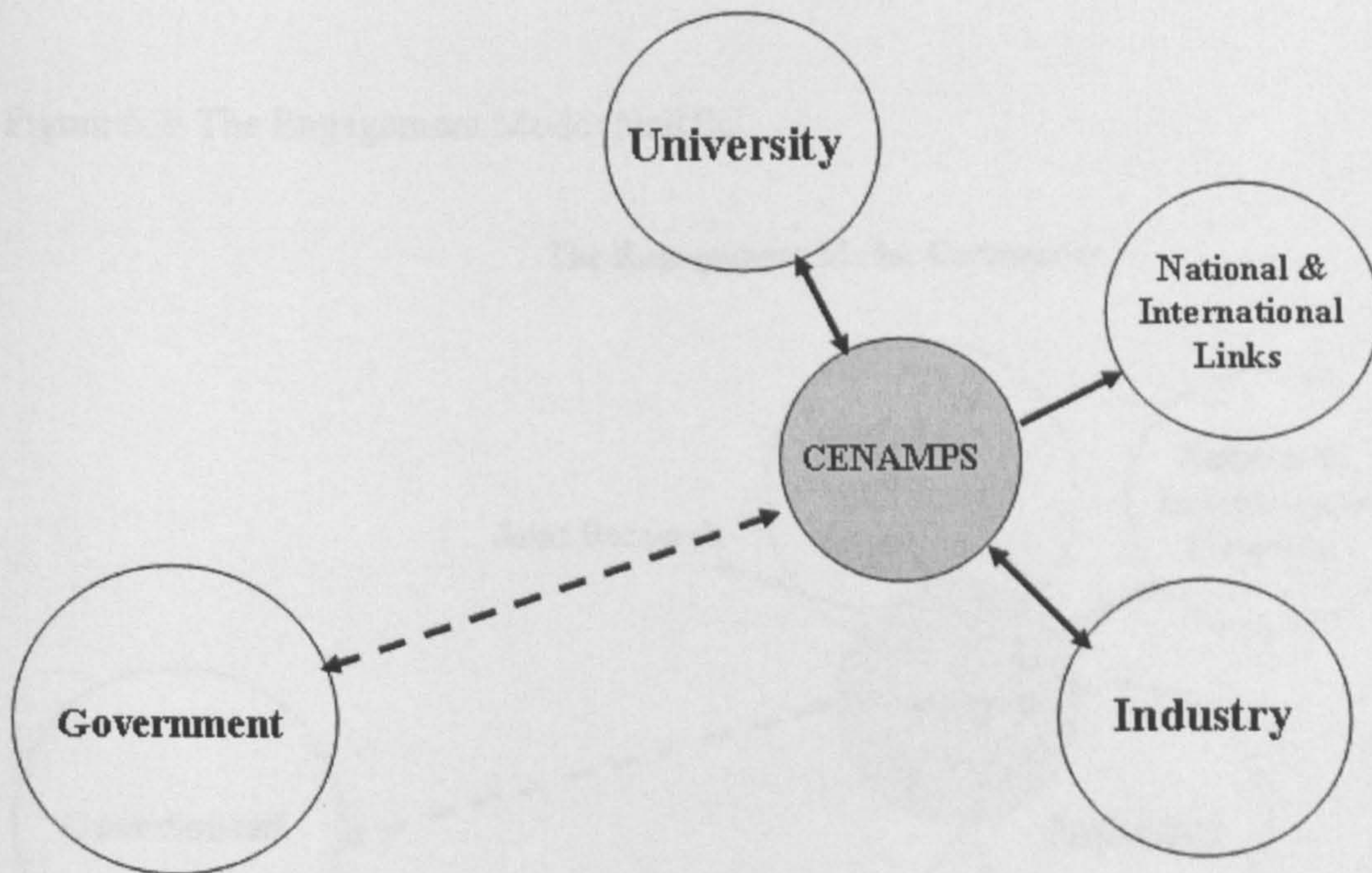


Figure 6.1 The Engagement Mode:CENAMPS

**The Engagement Mode: NaREC**

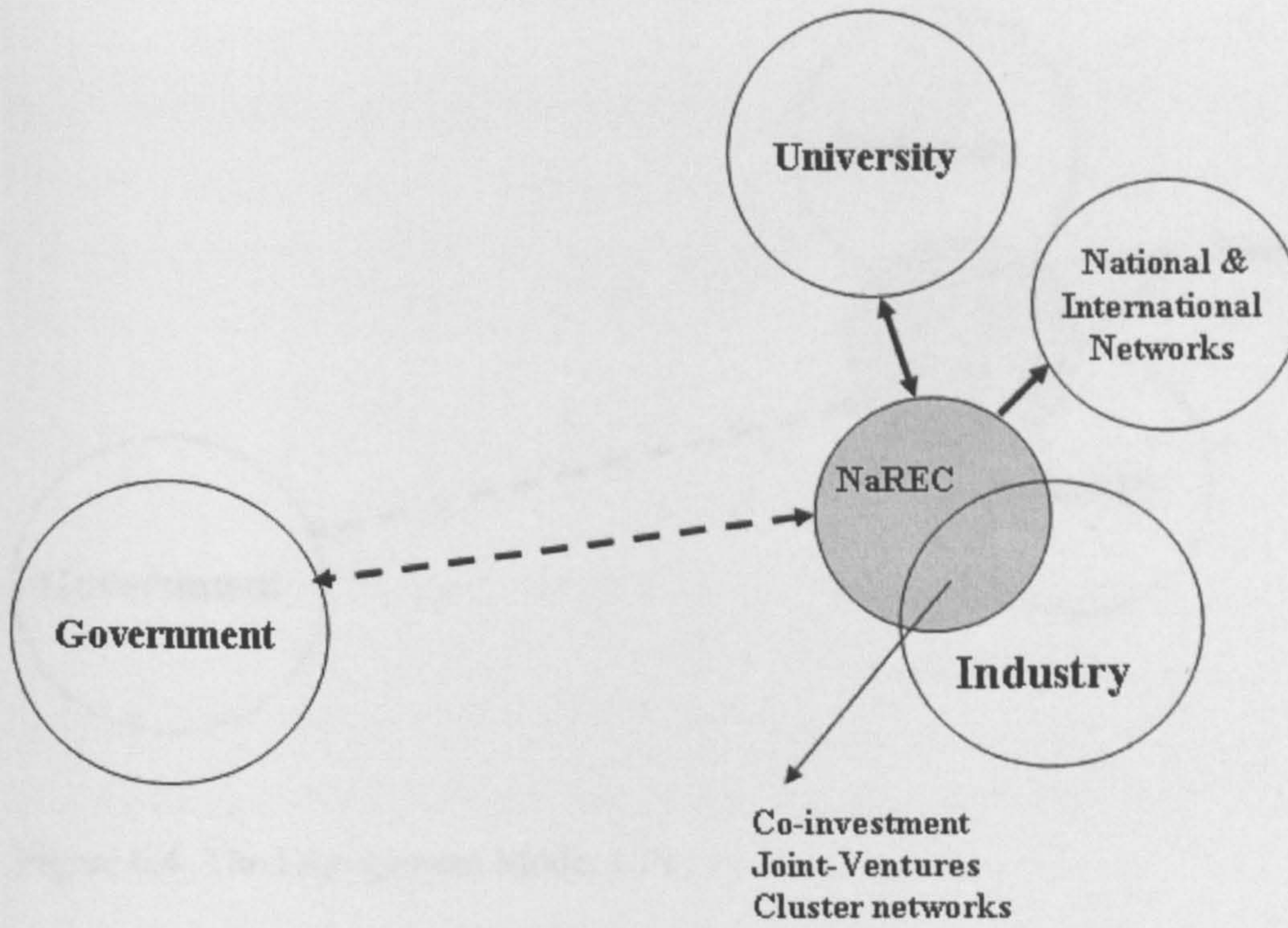


Figure 6.2: The Engagement Mode: NaREC

**The Engagement Mode: Codeworks**

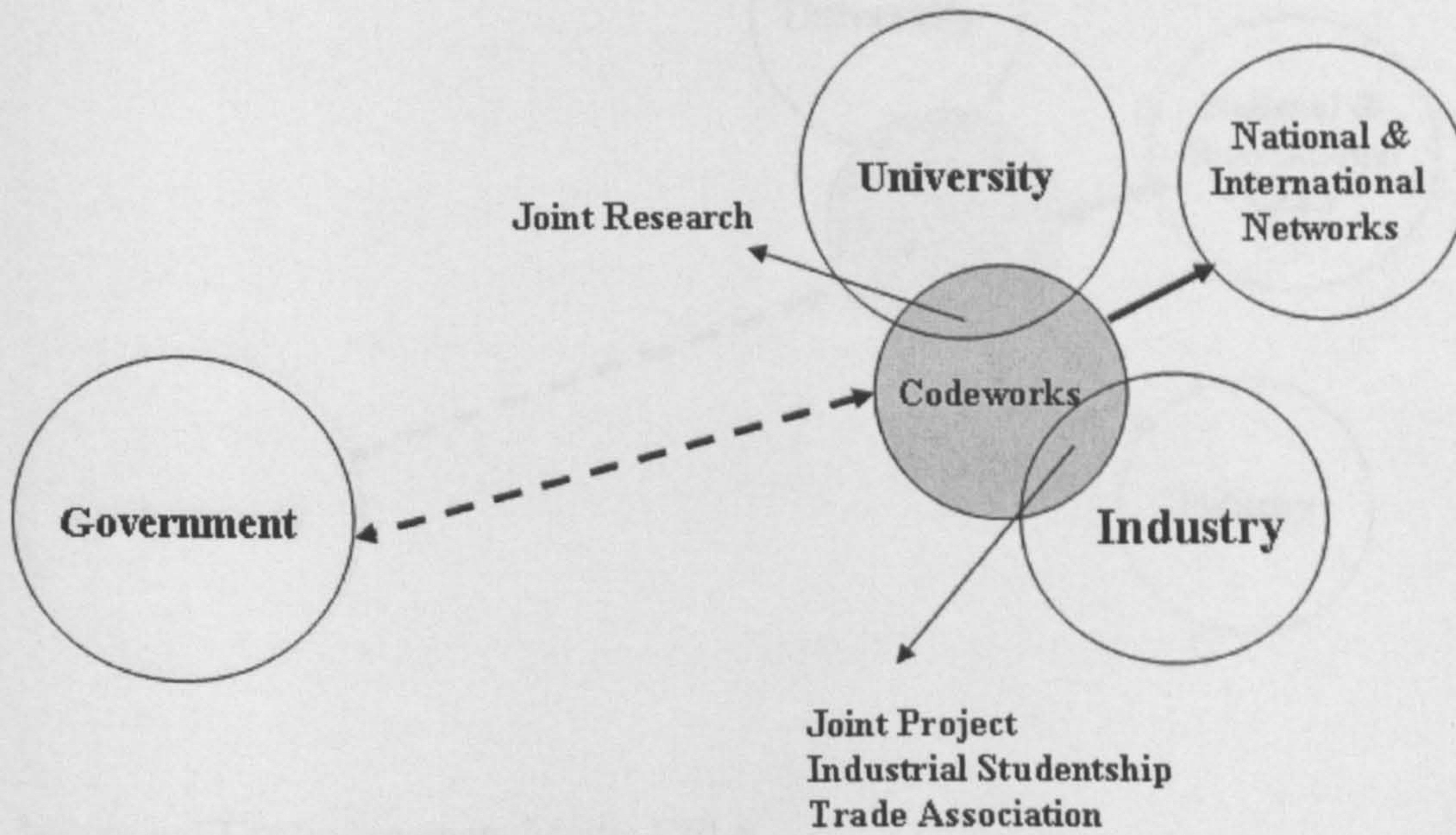


Figure 6.3 The Engagement Mode: CodeWorks

**The Engagement Mode: CPI**

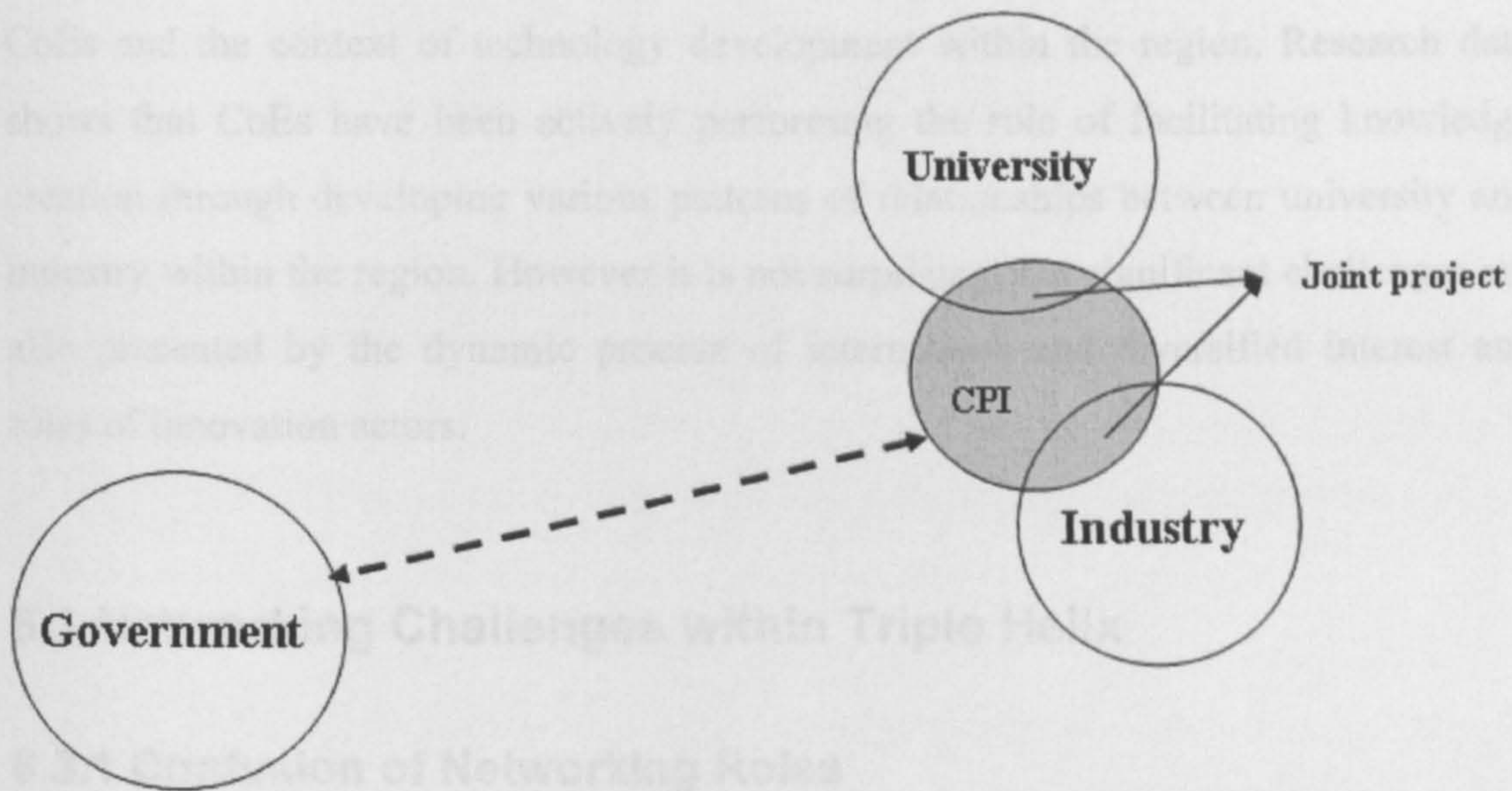


Figure 6.4 The Engagement Mode: CPI

**The Engagement Mode: CEL**

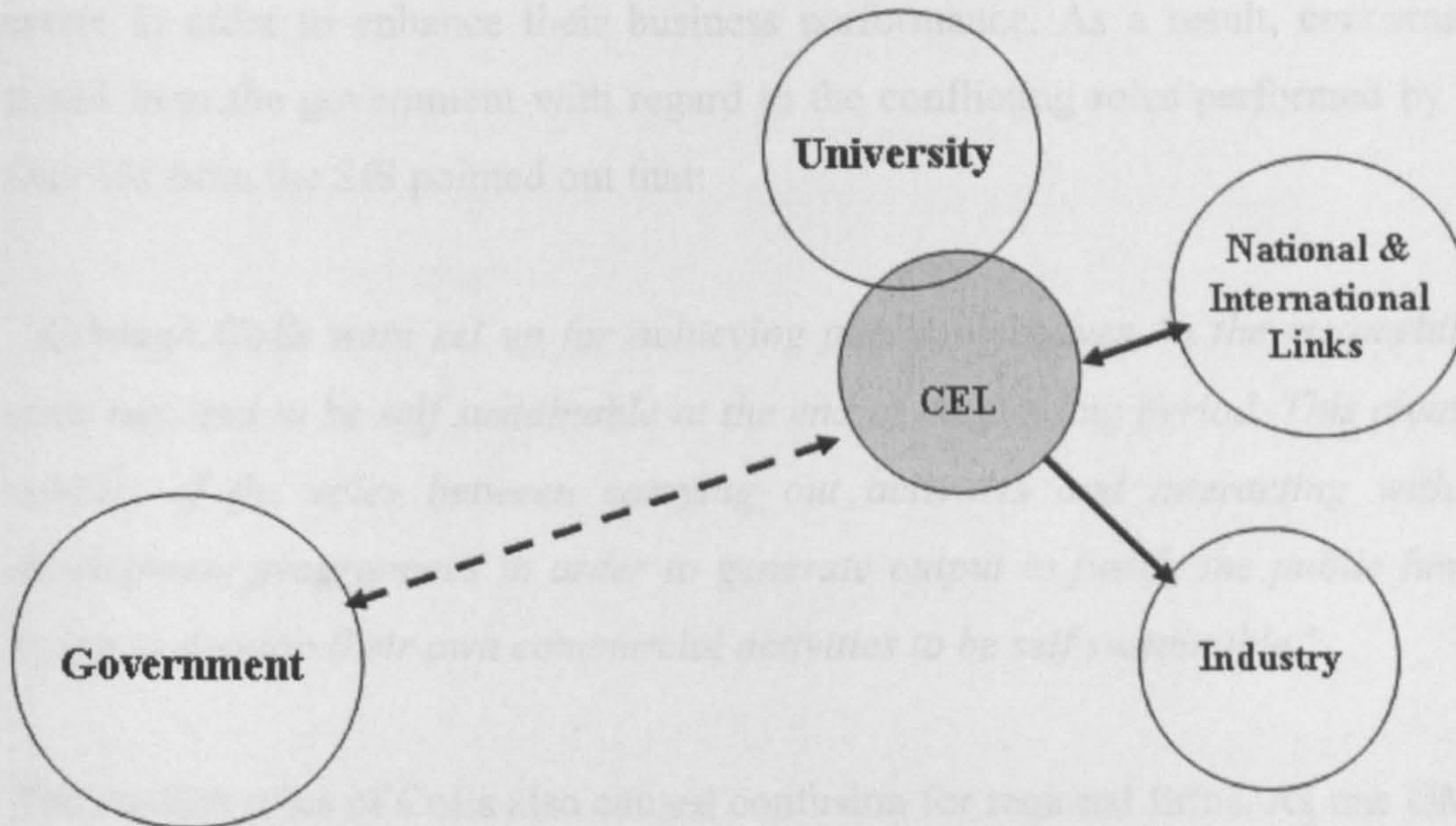


Figure 6.5 The Engagement Mode: CELS

The conceptual model of the Triple Helix relations within the SfS programme clearly shows that there is no fixed model of implementing knowledge-based innovation, the relationships developed between the CoEs and the three dimensions of university,

government and industry vary depending on the organizational strategies of individual CoEs and the context of technology development within the region. Research data shows that CoEs have been actively performing the role of facilitating knowledge creation through developing various patterns of relationships between university and industry within the region. However it is not surprising that significant challenges are also presented by the dynamic process of interactions and diversified interest and roles of innovation actors.

## **6.3 Networking Challenges within Triple Helix**

### **6.3.1 Confusion of Networking Roles**

Among the dynamics of networking challenges, one of the significant issues facing CoEs managers is the interpretation of their image and identify. It is identified that the CoEs viewed themselves being created as a separate entity from the government agency but coordinated through SfS team which is from the government agency. It is the completely new identity separated from the government that the CoE wanted to create in order to enhance their business performance. As a result, concerns were raised from the government with regard to the conflicting roles performed by CoEs. One SM from the SfS pointed out that:

*'Although CoEs were set up for achieving public objectives, in the meanwhile they were required to be self sustainable at the end of the funding period. This created the conflict of the roles between carrying out activities and interacting with other development programmes in order to generate output to justify the public fund, and trying to develop their own commercial activities to be self sustainable.'*

The conflict roles of CoEs also caused confusion for regional firms. As one OM from a regional firm pointed out that *'we are not quite sure what exactly the role CoEs are playing and how they function and relate to other business support networks in the region.'* In addition to the self-perceived identify and roles by the CoEs and the confusion of regional firms, the functions and roles of CoEs are further complicated by different perceptions from other regional partners that are engaged in the innovation networks created by the SfS programme. For instance, CoEs are perceived

as a centre of providing information on technology development within the region. Consequently, the CoEs was expected to develop their abilities of exploiting key information and knowledge within the region. For instance, a SM from the university pointed out that:

*'CoEs as links between university and industry, it is not enough to know that the region is strong in five technology areas, we need to have more evidence. In order to do this, the CoEs need to develop their ability to know what's happening in the university, mapping out the knowledge and expertise in the region'.*

The conflicting roles of CoEs and different perceptions from their regional partners not only lead to the operational problems during innovation networking but also resulted in the problem of overlooking other important innovation projects that could have contributed to the overall knowledge creation strategies of CoEs. Due to misunderstanding on the roles of CoEs, some of the key projects that are conducted by the City Council for instance were not able to attract enough attention from CoEs. Consequently, some special technological project which has the potential significant impact on regional innovation was implemented independently from CoEs. As the SM from the city council described the relationships with CoEs as *'loose and informal relations'*. The OM from city council further commented that *'there are certainly regular contacts at strategic level through executive meeting at institutional level organized by the RDA. However, we don't have any operational links in terms of technology transfer and commercialization projects. We have our own technology transfer office which aims to promote the city being an innovative place to attract potential investors.'*

Despite of CoEs' claim as independent companies and separated from the RDA, they were still perceived as part of the government bodies or the technology arm of RDA by private companies within the region. Consequently, the CoEs were approached for the purpose of grant funding by firms in the region. In addition, the functions and activities performed by CoEs seemed to remain ambiguous not only for the local firms, but also for their working partners in the region. Results from the interview shows that despite of public stated functions and roles of CoEs in facilitating knowledge creation in the region, in general the role of CoEs remains ambiguous at

operational level in terms of what exactly CoEs can offer to their regional partners as well as the local firms. One of the main reasons for the confused roles of CoEs, as pointed out by the interviewees, is the way CoEs were set up as private organizations with public duties. This has caused conflicting strategies for CoEs when operating in the network environment. Managers from CoEs found it difficult to decide on business priorities and time spent on performing and managing innovation tasks.

On one hand, CoEs managers were required to perform public objectives in order to fulfill the knowledge economy criteria and justify the public funding. On the other hand, due to the CoEs were set up as private companies which were expected to achieve self-sustainability thereby had to operate in private terms. How to manage the balance between public and private agenda was viewed as one of the key challenges facing the senior management of the centres. It was highlighted by the senior managers within the CoEs that the centres were created to be independent and entrepreneur. However they were operating in a public sector framework and had to deal with bureaucratic institutions with layers of management, which has created significant challenges for the managers.

The private nature of the organization requires the operation is efficient and business-driven. When CoEs managers were asked about how they manage the relationships between public agenda and self-sustainability driven by the private nature of the centre, it was felt that because of the responsibilities of carrying out public duties, the managers from the CoEs have to be very cautious about the ways of operation when pursuing their own business development strategies. As the SM from CENAMPS put it, *'it was difficult to set up the centre as consultancy as it will conflict with out public agenda.'* Comments from CoEs managers also indicate that although the CoEs can develop their own commercial activities, it is important not to be seen in the competitive position against other organizations in the region, partly because *'half of our body represents the public sector and government'*. (CodeWork JO)

### **6.3.2 Congruence of Strategic Focus**

One of the key challenges facing CoEs managers is the difficulties of achieving consensus on the strategic focus of CoEs for developing knowledge-based innovation in terms of what should be the strategic focus of CoEs when facilitating the process of

innovation. Different opinions have been identified from the research interviews.

### 6.3.2.1 Target Specific Technology

Although the CoEs were created to exploit five key technology areas that are identified to be the potential for the region, there are far more potential links within each technology area and specific issues related to each technology area that can be further developed and exploited. Therefore the key challenge facing each centre is how to identify the potentials of specific areas within the generic technology framework and successfully explore and exploit new knowledge thereby generating innovation capacities with the region. One SM from the regional firm commented that:

*'The areas of technology identified are such big areas and it doesn't help much in terms of understanding exact the competitiveness of the region. The competitiveness of the region should be based on a more specific area of technology and it is an on-going process. In addition, there should be more specific information available for companies to make business decision of investment for a particular technology or innovation'.*

However identifying the specific areas require more efforts spending on developing extensive networks and contacts and collecting information on updated research outcome, new ideas and publications, latest market trends as well as new policies from the government in terms of support available for new trends and development. Thus though exploring more specific technology areas was preferred in an ideal situation, it is easy said than being done due to limited resources.

What's more, due to CoEs were created with limited public fund and they have to be self-sustainable within five years. The CoEs therefore have to develop focused strategies to prioritize certain technology areas for business purpose. The CoEs did recognize the concerns that their activities might not have covered wider enough to cover all private companies. As the JO from NaREC highlighted the dilemma of identifying specific technology and explained that:

*'We are newly established companies, there are quite a lot expectations on what we should do from the stakeholders, we also have to achieve self-sustainability. There are a lot to be done, however there is limited resources available. '*

Given the configuration of CoEs, it may be correct from them to prioritize some key activities in the early stages of development. However, as a result of the focused operational strategy, companies which have not been approached or included in the targeted areas of technology have little knowledge about what CoEs role is and therefore start to question about the effectiveness of the role played by CoEs with regard to bridge the knowledge gap between university and industry.

Though the CoEs had been trying very hard to promote knowledge transfer in targeted technology areas in the region, the issue of not being able to provide service on more specific technology areas resulted in some regional firms taking the opportunities away from the region and seeking innovation support outside the region. During the process of interview, an OM from the regional firm admitted that they were collaborating with a university outside the region for researching and developing new product. When the manger was asked about the reasons on why not conducting R&D within the region, it was pointed out that *'we need information on the specific technology that we rely on for our business. However we know the CoEs are focusing on certain technology areas. Our technology, as far as I know, is not covered by the CoEs.'*

The problem of achieving consensus on which area of technology needs to be focused on is also reflected from the overlapping of innovation tasks taken by the university and CoEs managers.

### **6.3.2.2 Focusing Information Processing**

With the increasing awareness of the important role played by university in the knowledge economy, there has been a trend within the university in moving towards more commercial oriented institutions, or at least a tendency to transform certain part of the university to become commercial-driven. Whilst the university perceive itself as expertise of the technology, tensions occurred between the CoEs and universities in



terms of agreeing on the targeted areas of technology to lead the development of knowledge-based innovation within the region. Consequently the innovation tasks performed by CoEs were seen to have been overlapping with the commercial arms of the university, in particular when the innovation activities were conducted in the same technology area for commercialization and technology transfer.

The argument from university side is that the CoEs were established as facilitating organization and should function as an information centre from which other innovation actors can draw useful information related to new technology development in the global market, specific information on local firms and regional expertise. Therefore the assumed role of CoEs at institutional level was information processing organizations, i.e. collecting useful information and communicating to relevant innovation actors who could use them for generating new knowledge. It was believed that the university has the capacity of commercializing and delivering innovation projects as well as the generating new knowledge. In another word, university should take the lead in knowledge application through developing collaborative relations with industry directly. The structural facilitation that was created by the CoEs was not perceived adding much value in the process of knowledge creation other than acting as intermediary organizations and providing relevant information for innovation actors to make decisions on the appropriate strategies for developing new technology and innovation project.

Although the both CoEs managers and university business development managers were aware of the issues of overlapping innovation tasks which to some extent caused conflicting strategic relations at institutional level. This did not seem to prevent daily interactions between operational managers in terms of information exchange and sharing the development of innovation projects. The unique relationships between the commercial teams and CoEs managers were described as 'competition and complementary' during the process of interaction. On one hand the CoEs have to add value in the process of developing knowledge-based innovation by exploring and exploiting new knowledge from the university into industry. On the other hand, the managers had to be careful of not stepping into the technology transfer services within the university and competing with the business development activities carrying out by university managers.

### **6.3.3 Coping with Institutional Culture**

Despite significant effort of CoEs managers in creating and maintaining effective network relations with university academics and positive outcomes generated from the successful relationships established with university academics at operational level, there are still a number of challenges derived from the forces of institutional inertia that need to be considered.

#### **6.3.3.1 Bureaucratic University System**

Evidence shows that dealing with the university system appears to be more challenging than dealing with the differences between academic and business culture. It was felt that the bureaucratic system might have killed the great ideas before they could be formalized into a business opportunity. Academics won't be bothered when they found that they had to go through layers of management systems as well as managing their day to day teaching and research work.

Data collected from interview also shows that universities tend to have different approach towards commercialization based on their own research strengths and strategies. Traditional university is more research oriented in order to secure or satisfy public funding from the government. Although developing technology transfer and commercialization has been paid increasing attention by top management within the university, the supporting system within the university and relevant procedures was perceived as not sufficient to motivate academic staff to engage with industry. Research shows that some new universities which are not traditionally research-oriented tend to be more active in collaborating with industry. The logic behind this approach is that through more collaboration with industries and carrying out applied research, funding received from industry can be used to further support academic teaching and strengthen university's capacities of conducting basic science driven research. Another benefit that was pointed during research is that collaborative relationships with industry through joint research tend to last longer due to trust relations that were built up between individual researchers and industrial managers. As a result, the return from university perspective is not only in terms of funding but also the development of more research opportunities and academic publications.

Due to various university systems, the CoEs managers had to adopt different

strategies of developing collaborations with universities. Frustrations occurred when managers had to identify ways of communicating within the bureaucratic system at various levels. Sometimes it could be very sensitive, as one CoE JO pointed out that:

*'when discussing important progress of certain commercialization projects, we need to make sure that our presents in the university known to the business management team within the university and we need to be invited by the professors.'*

The problem of university system also appeared due to lack of internal communication within the university between academics and the administrative people who manage the procedures of technology transfer. Because academics felt that although the administrators could assist relevant documentation and the legal process in terms of managing and protecting IP related issues, they were not equipped with sufficient expertise and understanding on the technical aspects of the project. The academics would prefer talking to people who have knowledge on both technical aspects of the technology as well as how to commercialize them.

#### **6.3.3.2 Bridging the University - Industry Culture Gap**

The culture gap between academics and industry has been addressed as critical factor during the process of technology transfer and commercialization (Langberg, 2002, Etzkowitz and De Mello, 2003).

Research findings suggest that there is a default position among the companies which are to some degree sceptical about the capacities of university in working with commercial sector, especially in some sectors where technology are developed so quickly in the market place and how university react to the changes and adapt its role in the business environment remains a key issue. In addition, interviews suggest that university researchers and business managers from the industries have different agenda and concerns on innovation generation and diffusion. For university researchers, it is important to pursue long term value and real innovative research which have impact on the academic world. Whereas business managers are concerned about efficiency of R&D and under the pressure of deadline of developing new product to adapt the changing market. Therefore from industrial perspective, the collaboration is often driven by tight business plan within a short period of timeframe.

In order to facilitate and bridge the culture gap between university and industry, the CoEs managers had to sit in the middle and negotiated with both sides in order to change or influence the business model that both satisfies the academics for conducting a longer term research project, and industrial managers for meeting the demand of the changing market.

The culture gap was also manifested in different attitude of university academics towards sources of funding to support their research. It was observed that academics tended to rely more on government funding than financial support from industries when conducting their research. The main reason identified was related to the time pressure from industries in generating applied research within a short period of time. The result-driven culture within industries is clearly in contradicting with the academic culture in the university which emphasizes the process of research that leads to the outcome.

Despite different mindset between industries and academics, the CoEs managers did not feel that it would prevent them from pursuing the knowledge-based innovation agenda and seeking commercialization projects. In fact, the differences were quite appreciated by some managers from the CoEs who had sympathy on those professors who have to manage both academic teaching and their own spin-off companies. There was opinion among the CoEs managers that people who are interested in fundamental research should continue doing so, however the university needs to create flexible system to allow people who are capable of doing applied research to develop in this direction. As it was pointed out by a CoEs SM that:

*'The brightest people in research are never going to be commercial people, they have different identity. The commercialization should not put pressure on academics. But a flexible system needs to be established to encourage those who are good at industry and work with industry. The commercial aspect can be taken by people who are capable and willing to do the task'*

### **6.3.3.3 Overprotection of Information**

The fundamental purpose of building up interactive networks is to seek relevant information for innovation. However one of the main difficulties facing CoEs

managers is to cope with the sensitivity of technology-related information when working with university professors and technology transfer managers within the university. The importance and sensitivity of Intellectual Property Rights during commercialization of new technology is well recognised by CoEs managers, however in the business context, some information needs to be shared in order to develop an initial interest between collaboration partners for technology transfer project. CoEs managers felt that to a certain extent information is overprotected by the university, which caused difficulties of exploring innovation opportunities.

Data collected from research shows that university is reluctant for certain knowledge to be released to external organizations to exploit as this could lead university in the less variable position in protecting the IP generated from the academic world. Such attitude was underpinned by some historical reasons. As one university manager put it:

*'University used to be extremely immature in its approach to IP protection and commercialization. I think it is not too strong to say that the university has been rapped off by some companies who have used university's facilities and resources to generate IPR and then university was not acknowledged at anywhere.'*

Though the importance of protecting IPR was well aware of by managers involved in the commercialization process, there seemed to be lack of practical guidance on how information could be shared during the process of negotiating projects with industries. For instance, a university researcher pointed out that:

*'we are scientists and we would like to be straightforward, we just talk about what we know and tell them the facts. However the marketing and business managers are different, they will select information when they talk to potential clients. Because if we tell them all, they would have all technical details and we are no longer needed to transfer this technology. Other people can do the job'*

The key issue is how to manage the balance of sharing necessary information to move the project forward whilst protecting the IPR to ensure the success of technology transfer and commercialization.

### **6.3.4 Challenges of Partnership**

Although creating the CoEs is an important part of knowledge-based innovation strategy to explore regional strengths and enhance innovation capacity, the operation of CoEs, as part of the overall SfS programme, is associated with other innovation initiatives in the region. In particular, there are various interactions and project links between the CoEs and the inward investment teams (IIT) and the cluster team within RDA.

For instance, whilst the CoEs are thriving for raising the profile of the region nationally and internationally as the destination for R&D and investment for new technology, the inward investment team shares similar objectives by attracting global investors into the region. In addition, the cluster team within RDA also established a range of industrial networks within the region. Thus working in partnership with the Inward Investment and Cluster Teams within RDA is seen as an important task for CoEs to have insights on the regional industrial networks as well as developing international profile of the technology strength in the region.

However data collected from research shows that the philosophy of working in partnership under public sector framework has been challenged in a number of ways.

#### **6.3.4.1 Problem of Collective Actions**

Cooperation through collective actions has been widely acknowledged as essential for effective partnership working practice. However under the common strategic purpose for generating regional innovation capacities, the working relationships between RDA (IIT and Cluster team) and CoEs were felt loose and informal due to different understanding on the strategic priorities and expectations on the partnership roles. The OM from RDA pointed out that,

*'when CoEs were set up, there is no clear definition on how it would function and operate, thus there is no clear rules and procedures on how we should be working together in a collaborative way as well as sharing information and resources'*

As a result, the IIT sees CoEs as part of the regional offering, which can be used as a 'selling point' for attracting global R&D investors. Therefore there should be a close partnership relationships and regular communications between CoEs and IIT. The

CoE are seen as the knowledge and information centre which can demonstrate the technology strength of the region. The problem of cooperation occurred due to actors within the partnership are driven by different priorities and operational focus. The IIT felt the CoEs are not cooperative in collecting and providing specific information on the areas of technology or strengths for them to effectively promote the region to potential investors. However the CoEs felt they had already been over tasked by coping with self-sustainability as well as working with regional university and industry on various innovation projects. As one of the CoEs manger pointed out:

*'we are small organizations and we have already been very busy on existing priorities. It is difficult for us to respond timely to all enquires since everyone within the organization is involved in a number of projects'*

Although the effort from IIT is appreciated by CoEs in terms of generating international enquires related to new technology and innovation opportunities within the region, these enquiries are seen too general to target from CoEs point of view and therefore not worth of effort for following up.

The challenge of collective action is also evident in who is taking the leading role in promote the region internationally. Traditionally, promoting the region in the international market is seen through the generation of inward investment in the region. Therefore the IIT has been playing an important role of generating international enquiries and bringing in new technology and global investors into the region. It is believed that the IIT should continue the role of leading all aspects of the region's international development strategy in which generating innovation capacities is viewed as a critical element. Under this assumption, the IIT treated CoEs as part of what regional offering and should support the IIT in providing necessary information on the technology strengths so that more investment can be attracted into the region. From IIT point of view the priority of CoEs should be inward looking, facilitating network building between research bases and industries and bridging the knowledge gap within the region to create an integrated knowledge infrastructure.

However, the CoEs perceive themselves as independent organizations which have their own international strategies to develop their global reputation of 'Centre of Excellence' in relevant technology areas by taking the advantages of their own

international links. The CoEs argue that with nature of the CoEs that both have public and private objectives to achieve, they need to prioritize certain activities rather than spending time on 'scattergun' contact building and involved in all enquiries raised by IIT. The CoEs need to be strategic focused. As CoEs manager indicated:

*'After all, it is the projects that make the real differences. We are not a messenger boy, we are delivery boy'.*

In addition to the problematic partnership between CoEs and IIT, interview data shows that the working relations between CoEs and the cluster team also did not function as prescribed in the SfS innovation programme. Under the design of SfS innovation programme, the CoEs is assumed to work closely with the cluster team to engage with regional industries and identify the industrial needs of new technology. Although a few individual contact was established between CoEs and the cluster teams at the project level, the effort seemed to be in vain due to constant internal restructuring within the RDA and the changing cluster strategies within the region. The CoEs managers found it difficult to build up and maintain stable relationships with the cluster teams. Observation shows that the CoEs in fact had developed their own business networks within regional firms in order to identify key business contacts and try to establish the clusters around the targeted technology area.

#### **6.3.4.2 Difficulties of Transforming New Roles**

Performing innovation tasks requires the CoEs understand business and academic culture as well as the relevant policy process from government perspective. The appreciation of the university, government and industrial dimension of networking needs to be developed not only at the strategic level of CoEs by the senior executives, but also at the operational level by individual managers working within the centres.

However research data indicates that due to the nature and set up of CoEs, most of the team members of CoEs are from private sectors and some are even from outside the region. These managers were used to working in the private sector and driven by projects, tasks and meeting deadline. In the business-driven culture, projects are clearly defined and relationships are clarified with individual responsibilities. However, in the context of working within public partnership, actors are linked



through policy intentions of creating knowledge-based innovation, there are no clear defined responsibilities and reporting systems between individual actors. Certain degree of frustration occurred when the business-driven managers had to deal with the loose, informal public partnership working culture. As one CoEs manger pointed out that:

*'working in public sector requires people to work together and share information, in particular you need to think about whom should be involved. However we are business-driven and entrepreneurs, and have to be focused on our own tasks, it is time-consuming to deal with the slow system of communication within the public sectors'.*

Although on-going dialogues between the senior members from CoEs and RDA with regard to setting up the protocols and trying to improve the situation to react more opportunities for sharing information, the implementation of these protocols for improving communications and collaborative relationships seem to be an issue due to busy innovation tasks conducted by both CoEs and teams within RDA.

What's more, a number of interviewees suggested that as new established organizations, the CoEs are still in the process of configuring the new role to adapt in the complex networking environment and dealing with various relations with university, government and industry. The transformation of new roles takes time and managers need to develop understanding on different operating systems emerged from different institutional dimensions, particularly when these procures and ways of communication are affected by specific technology area which they are targeting.

## **6.4 Conclusion**

This section described the implementation processes of knowledge-based innovation with particular focus on how CoEs, as new established organizational configuration, enact their role as innovation facilitator to encourage cooperation and collaboration between university and industry for knowledge generation and diffusions.

The Chapter started by presenting the nature of relationships between the CoEs and the three key innovation actors: university, government and industry within the SfS

programme. The operational strategies of each CoEs and a wide range of innovation activities conducted by the CoEs in establishing working relationships with industry, university and government have been described and the key features of the Triple Helix relationships inside the implementation of SfS have been highlighted in terms of different mode of engagement adopted by CoEs.

Research findings show that the effort of CoEs has produced positive results in terms of building up interactive relationships at operational level with university professors and a range of industrial actors and facilitating shared understanding between individual academics and industrial managers during the process of collaboration.

Notwithstanding the significant role of CoEs in creating cooperation relations between university, government and industry at operational level within the region, a number of critical issues have been identified during the process of networking. The network challenges presented include different opinions and interpretation on the function and strategic focus of CoEs, coping with institutional system and culture gap between university and industry as well as difficulties of working in partnership in the public settings. These challenges have not only brought about operational difficulties in terms of effective communication and information sharing within the innovation networks, but also affected motivation of innovation actors when conducting innovation activities for knowledge creation.

From the evidence collected during research, it is clear that the CoEs have achieved progress in certain areas of technology exploitation and exploration and building up networks at regional, national and international level. The success is particular evident from positive feedback from individual academics and close interactive relationships industrial managers. However areas of problems emerged at organizational and strategic level during the process of networking are also apparent and should not be ignored if the SfS programme was to sustain the progress in the long term.

The proceeding Chapter will address the theoretical implications of the issues identified during the implementation of SfS innovation programme and how the issues of concerns challenge the theory of Triple Helix model of knowledge-based innovation.



# Chapter 7 Analysis and Discussion of Research Findings

## 7.1 Introduction

Previous Chapter presented the research data collected from the main study CoEs developed innovation networks with university, government and industry for generating innovation capacities in the North East of England and the networking challenges during the process of implementation. This Chapter will focus on exploring the theoretical implications of research findings in relation to the theory of Triple Helix and discuss how the critical issues presented within the Triple Helix model of knowledge-based innovation are reflected or challenged in the North East of England.

The discussions and analysis will be structured as follows. It will begin by discussing the issues that need to be addressed during the implementation of Triple Helix in terms of the cooperative relations, the coordination mechanisms and how the transformational relations are managed during the process of interaction. The analysis of cooperation within Triple Helix will examine the extent to which cooperative relations between university-government-industry is a result of common interests for generating knowledge-based innovation. The coordination of innovation networks will explore both content of innovation activities and the process of interactions to identify the key mechanisms of coordinating innovation networking within Triple Helix. The challenges of transforming relations within Triple Helix will be analyzed and the importance of managing of change and learning in adopting new patterns of innovation will be emphasized.

Based on the close examination of Triple Helix model and the analysis of the key issues to be addressed during the implementation of knowledge-based innovation strategy in the North East of England, a more appropriate model of Triple Helix is proposed with particular attention paid on the strategic value of the new organizational configuration in the process of generating innovation capacities within the North East of England. Finally, a strategic framework of implementing Triple

Helix model of knowledge-based innovation in a regional context will be established and demonstrated.

## **7.2 Issues need to be addressed within Triple Helix Networks**

One of the important conditions emphasized in Triple Helix model of creating knowledge-based innovation is cooperation relations between university, government and industry. It is certainly evident that high performance regions are featured by interactive relations and collaborations between university, government and industry, although there is little evidence on how the cooperative relations in high performance regions were established. Close examination of the networking practice within Triple Helix model based in the North East of England indicate that the innovation actors performing the networks faced a number of difficulties both at the strategic and operational level.

### **7.2.1 The 'Hidden' Strategic Intentions**

The 'Hidden' strategic intention refers to the diverse organizational agenda underpinned by different interpretations of innovation problems in the region, but have not been explicitly expressed during the process of developing cooperative relations. Policy implementation is a process of translating strategic intention into practice in which actors exchange information about problems, share ideas and resources and establish common interest and objectives. The success of policy implementation depends on the realization of collective actions of participant organizations within the networks. However the TH model is under the assumption that the strategic intention has been well-defined and shared, thus the relationships established should be 'cooperative' in nature, the hidden strategic intentions from individual actors are undermined. As a result, issues and problems occurred during implementation stage are usually identified as the problem of coordination and communication, there has been little analysis on whether the 'hidden' strategic intention of actors has been clarified and shared.

Research findings suggest that concerns associated with coordination and communications within the innovation networks should not be simply regarded as an implementation issue. The problems are indeed embedded in the fundamental understanding of the innovation problems which might not have been clearly defined,

understood and agreed during the process of forming cooperation relations between innovation actors. Although the need to establish a cooperative structure between key innovation actors has been recognized in various policy documents, there is little explanation on why there was lack of interactions and cooperation within the region in the first place. In stead of explicitly defining and agreeing on the innovation problem, the solution of enhancing cooperation within the region is agreed as the solution for create the knowledge-based innovation. Robert (2000) pointed out that without a definitive statement of what the problem is, there can be no definitive solution. In fact, there could be competing solutions created by stakeholders involved in generating solutions based on their own interpretation of the problem.

It has been identified that the innovation problems within the region were interpreted from different perspectives including shortage of funding for spin-off companies, lack of information on new invention and research expertise, lack of innovative and entrepreneurial culture within the region, and mutual understanding on IPR. Due to different interpretations of innovation problem, the approach to develop solutions is driven by self-interest and individual organizational agenda. These individual organizational agenda are often hidden and rarely expressed during the process of developing cooperative relations since cooperation needs to emphasize common interest rather than agenda of individual actors. Consequently, innovation actors perform networking activities based on their own interpretations of the functions and roles played by other actors as well as the procedures of interactions.

The 'hidden' strategic intentions under the umbrella of developing knowledge-based innovation identified from the network partners are elaborated as below:

- From government perspective, the CoEs are created as a facilitator of innovation and it should focus on the exploitation of the research potential of the region and cooperate with other government initiatives to form a coherence and interactive system of innovation.
- Within industries, innovation needs are driven by individual organizational strategies for growth, the nature of the business and resources available for research & development.

- University as knowledge generation institution is keen to play a leading role in the knowledge economy by actively engaging with industries and developing a global focus and international leading research institution.
- Although CoEs were created by the regional government to bridge the strategic interests of various innovation partners and facilitate cooperation. The CoEs as an independent organization also have its own strategic focus of developing global reputation and excellence in relevant technology areas.

As a result of the 'hidden' strategic agenda within the innovation networks, the common objective for creating knowledge-based innovation is undermined by individual organizational strategies and overlapping innovation activities conducted across institutions. Mobilizing collective actions and developing cooperative relations are hindered by the difficulties of sharing information between innovation actors due to protection of self-interests.

### **7.2.2 Lack of Institutional Arrangement**

The provision of institutional arrangement is recognized critical for developing cooperative relations during the process of networking in terms of defining functions and roles of innovation actors, clarifying means of communication and creating rules of interactions. Despite of the creation of the cooperation structure between university, government and industry, research findings indicate that there is lack of institutional arrangement to support new patterns of engagement for knowledge creation and provide operational guidance for developing cooperative relations. Therefore the CoEs had to work their own way to identify key contacts within the networks, building up operational relations through various means of communications and channels of interactions.

Lack of institutional arrangement caused a certain degree of tensions between the new patterns of engagement performed by CoEs and existing innovation networks embedded in the traditional institutional relations. In particular, when the organizational and operational strategies adopted by CoEs were not understood by innovation partners within the region. Because the CoEs are designed to focus on five specific technology areas, it is inevitable that firms which do not operate in these technology areas have been paid less attention due to the strategic priorities set up by

each CoEs. This has to some extent affected the motivation of regional firms in participating innovation networks created by the CoEs and the interests in developing innovation capacities within the organizations.

### **7.2.3 Different Perceptions**

Establishing cooperation structure does not necessarily mean the existence of willingness for cooperation between network partners. Lack of clearly defined operational procedures also created different perceptions at both strategic and operational levels on the role performed by CoEs within the innovation networks.

For instance, the role of CoEs from RDA point of view is to strengthen regional innovation capacity by facilitating interactions between university (knowledge creators) and industry (knowledge consumers). However the perceptions from university is that CoEs should act as an information centre to provide structured information and knowledge about regional technology strengths for those novel firms (firms new to innovation or new to the North East region) in order to promote the region. Due to the unique nature of CoEs having both public and private objectives, perceptions from industries were mixed and various. For instance, some firms regarded CoEs as an integrate unit of RDA therefore has the authority of granting public fund. Interview data also shows that some firms worked with institutions outside the region on R&D projects due to lack of understanding on the strategic roles of CoEs.

Since perception cannot be forced to change and it can only be shaped through the process of interaction, CoEs developed various strategies to engage with academics and local industries including organizing networking events, facilitating knowledge transfer projects. Particularly through personal interaction and process of working on the projects, information and knowledge are shared between academics, CoEs managers and private companies. Evidence suggests that because members involved in the networks are willing to reflect on their own needs and perceptions, mutual understandings are developed and thus new perceptions are constructed.

Data collected research indicates that the perception at operational levels is relatively



easier to be influenced through personal interactions. However the perceptions at strategic level is often associated with institutional norms, values and organizational visions for long term development and it is difficult to integrate organizational strategies which are driven by motivations and interests of individual innovation actors.

#### **7.2.4 Diversified Motivations and Interests of Innovation**

It has also been identified that diversified motivation and interests reinforced the perceptions of innovation actors on each other's roles during the process of networking. The real challenge for CoEs managers is to understand innovation problems that were raised by regional firms. Very often those innovation problems are mixed up with management issues such as how to manage current business in terms of raising finance, recruit motivated and skilled employees and identifying new market for the existing product.

On one hand, CoEs managers had to provide advice and support the management problems facing regional firms which are essential for organizations to develop capacities of innovation. On the other hand, it is important for the managers to identify and encourage real R&D project initiated by regional firms to developing technological strengths for innovation. In addition, business managers within industry are driven by customer needs, market trends, profitability and outcome. Thus they have to work on the tight schedule around product development cycle because delay on new product development may disadvantage the company in the market place and sometimes may cause market lost and company failure. Time and results are therefore the major concerns for companies involved in innovation networks and commercialization projects.

In the meanwhile, managing the motivation and interest of academic researchers also appears to be a significant challenge. Diversified interests were expressed from different corners including shortages of funding support for basic research, lack of incentive structures for academics undertaking commercial activities etc. Research findings indicate that academics are in general motivated by scientific achievement, publication, raising research profile in the academic world as well as complete for public funding. This is due to nature of science research is driven by the research

process including generating curiosity, developing diversified options, carrying out debates and confirming new ideas.

What has made the situation more complex is that motivation and needs of innovation actors are likely to vary from time to time during the process of interactions. In addition, the pressure emerging from meeting organizational business objectives and satisfying the public funding criteria have pushed CoEs managers into the direction of being more task driven and strategically focused during the process of interactions.

### **7.2.5 Coordination Issues within Triple Helix**

Coordination has been regarded as an important means of managing within networks. In the absence of formal control and direct management relations, how to mobilize collective actions through effective communication, negotiation as well as establishing social relations is critical for the success of networking. This section will explore the social and organizational perspective of Triple Helix by analysing how the CoEs managers coordinate the relations of university, government and industry and addressing the critical issues of coordination within Triple Helix. The analysis will be presented from three aspects: the innovation content, the innovation process and the role of leadership within the networks.

#### **7.2.5.1 Coordinating Complex Innovation Tasks**

The meaning of knowledge-based innovation, as discussed in Chapter 1, has been related to various aspects of knowledge generation and diffusion activities conducted in the economy. Although the ultimate objectives of the SfS innovation programme is to create knowledge-based innovation in the North East of England, the main innovation tasks for CoEs is the exploration and exploitation of new technologies within the region through creating and encouraging various technology transfer and commercialization activities between university and industry.

However analysis of research findings indicates that managing the content of knowledge-based innovation involves more than the creation of new technology and the procedures of commercialization. It has been identified that the term 'technology' and 'knowledge' transfer were often used interchangeable by innovation actors they tried to explain the coordination problems during the process of networking. In order

to clarify the content of innovation tasks related to technology transfer, the core elements of technology need to be understood. Li (2004) distinguishes four closely inter-linked elements of technology:

- Technique;
- Knowledge;
- Organization;
- Product.

It is clear that the academics researchers are often regarded as the best sources of creating the technique element of technology. However the knowledge of how a particular technique is commercially valuable rests within the industrial engineers and marketing managers who have better understanding on customer needs. Organization also plays an important role in providing strategies to sustain the value of new technology and finally, the technology needs to be transferred into marketable product which can be used by customers. In order to facilitate technology transfer, the CoEs managers not only need to understand the technical aspect of technology transfer process when negotiating with academic professors, but also have to appreciate organizational and business aspect related to the application of technology as well as understand the appropriateness and impact of a specific technology transfer on regional economic development.

What's more, facilitating knowledge sharing between university and industry in terms of creating shared understanding on the meanings of innovation is also an important innovation task carried out by CoEs managers. Innovation in science based research is measured in terms of the advance in knowledge, new means of research, know why, knowledge-how and know what. The researchers' performance is monitored by successful funding application and publication, whereas innovation from industrial point of view implies adding value to the existing product or processes, improving business efficiency, increasing productivity and generating profit. By facilitating knowledge sharing between university and industry, willingness and interest for cooperation between two parties are generated, which provides the basis for developing collaborations in relevant R&D and technology field.

### **7.2.5.2 Coordinating Dynamic Process**

The coordination challenges facing CoEs managers not only appear in dealing with the complex innovation content, but also manifest in the process of interactions which encompass set of relationships at strategic, operational and cross functional levels between the institutional spheres of university, government and industry.

#### **From Strategic to Operational**

The interactive processes are reflected from two dimensions: strategic and operational. At the strategic level, the CoEs need to manage the relations with vice chancellors from universities, chief executives from regional firms, representatives from business associations and senior government officials to discuss policy issues related to regional innovation and knowledge generation. It is during these meetings that common understanding on working together as partners and close interactions between institutions and sectors are achieved although there are no specific conditions or concrete plans developed on how the intention for 'working in partnership' can be translated into reality. In fact, the implementation plan and patterns of network relationships are evolved during the course of interactions at operational level when the actual meanings of collaboration and purpose of networking are translated into various events, projects and set of relationships. Although the strategic interaction leads to the partnership relationship at institutional level, such relationships are reinterpreted and reconstructed during the course of interaction.

#### **Network Integration**

It has been identified that the complexity of innovation content and dynamic interactions has resulted in duplication of innovation tasks and overlapping project initiatives within the innovation networks. Formal mechanisms of control of innovation process and integration of dynamic networks have been voiced by the actors involved the networks.

The duplication of innovation tasks conducted by different organizations has created tensions in terms of competing networking resources including information sharing, access to funding and research expertise. Lack of network integration also caused fragmented partnership relations between different initiatives and support activities within the Sfs innovation programme. Evidence suggested that the role of formal

mechanisms of control is underestimated by policy makers in terms of facilitating communication and enhancing cooperative culture within the Triple Helix networks. Thus the effectiveness of implementing the knowledge-based innovation strategy has been affected.

### **Trust Building**

The impact of social processes and interpersonal relations on trust building between actors has been widely recognized by many innovation theorists and organizational researchers. Empirical observation and interview shows that the word 'management' was rarely used by innovation actors. According to CoEs managers, it is important build up trust relations during the process of interaction. This means people do not feel 'being forced or controlled', but feel 'being helped and assisted' so that they are willing to share information and develop common interest. Trust relations identified during the interview can be distinguished at two levels. At the operational and individual level, it is clearly a high trust relations exist between individual university academics, business managers from regional firms and CoEs managers who are involved in day to day interactions and working on relevant technology transfer projects. The proximity relations at personal level helped managers to share information and develop common interests.

In addition, it was pointed out that trust relationship is not blind. Personal character is also seen as important in deciding whether cooperation can be established or not. It was indicated by interviewees that knowing whom you are working with is as important as knowing what he/she can do for your business. As people get to know each other better and interpersonal trust is established, commitment flows from both parties to work on the project.

Despite high trust relationships at operational level, the strategic and institutional relations appear to be in the opposite side due to divergent organizational strategies, institutional values, and different expectations of innovation actors. The underlying reason identified for the low-trust relations at strategic level is associated with the conflicts of political power and interests between institutional spheres as to who should take the leading role in creating the knowledge-based innovation in the region. As a result the concept of partnership networking will remain rhetoric for pursuing

self-interest.

### **7.2.6 Leading Partnership Networks**

One of the significant issues identified within the Triple Helix networks is the management paradigm of partnerships within public sectors. This means that partnerships are created through policy networks at institutional level with little formal procedures of communication and rules of interactions. Consequently, how to lead within the partnership becomes a key challenge for network partners.

During interviews, the importance of academic knowledge, industrial experiences and policy support were addressed from different institutional dimensions, which have led to different views on the leadership role in creating knowledge economy within the region.

#### **7.2.6.1 Lack of Shared Vision**

A clear vision is important to connect the aspiration and dreams of network participants and identify the core value of collaborative networks. As Collins and Porras (1996) argue a well-conceived vision consists of a core ideology and an envisioned future. In particular the envisioned future specifies a compelling long-term goal that serves as a unifying, focused reason for collective effort and vividly describes what it will be like to achieve the goal.

Having a vision is not sufficient to motivate joint actions unless the vision is articulated to individual participant's value, purpose and goals (Alexander et.al 2001). Although the vision for creating the knowledge-based innovation in the region is stated in the policy document, the core ideology or core value does not seem to be clarified with regard to what the CoEs stand for and why they exist between the institutional leaders within the innovation networks. The disagreement at strategic level has oriented to a degree of confusion at operational and individual level among network partners.

#### **7.2.6.2 Discontinuity of Networks**

In addition, changes within innovation networks in terms of organizational restructuring and changing leaders within organizations has resulted in the

discontinuity of network strategies and rules of interactions between innovation actors as well as institutional uncertainty.

As it has been discussed in the initial findings from pilot study, constant internal restructure caused personnel change as well as change of strategic directions of certain functions within the agency. Because the leaders with different experiences and background have different interpretations on the existing problem, therefore they tend to bring about different solutions. The institutional uncertainty not only resulted in external confusion from network partners in terms of the main contact, individual roles and responsibilities and decision making processes within the organization, but also caused internal frustration of existing business managers as they were concerned about their future jobs and could not concentrate on developing new initiatives and carrying on day-to-day networking tasks. In addition, Commitment from institutional leaders is important to strategize vision and internalize collective faith within the organization to create the conditions for effective networking at operational level. changes in leadership also leads to delay of formulating new strategic business plan as it takes time for the new leader to understand what is happening and adapt his/her new role in the institutional as well as collaborative networking environment.

Leading and mobilizing collective actions within partnership networks also require the leaders understand the needs of network partners and allocate resources to support the needs. However evidence from the research shows that the CoEs managers are facing the difficulties of collecting information and identifying key contacts as a result of constant changes and discontinuity of networks during the process of performing innovation tasks.

### **7.2.6.3 Involvement of Network Partners**

Under the partnerships culture in the public sector, innovation actors do not act upon formal rules, but based on a sense of involvement. Research evidence shows that actors who are actively involved in the process of interactions tend to be much motivated and committed for collaboration projects.

It has also been identified that involving the key individuals within the partnership organizations is important for the success of collaboration project as key contact

within the organization can influence the decision making process by exercising his/her personal networks, which then have an impact on the overall organizational strategies during the process of interaction.

### **7.2.7 Transforming Relations within Triple Helix**

Taking the role of each others between the institutional spheres of university, government and industry has been argued as one of the key features of knowledge-based innovation. Observations from the high performance region indicate that the capacities of innovation are enhanced as a result of academics becoming more entrepreneurial, industrial managers acting as academic researchers and government officials taking the role of business management. However, what has been implicit within the Triple Helix theory is the extent to which the transformational changes, if any, has affected the existing roles performed by the innovation actors and the institutional norms and values associated with the historical context of the region.

#### **7.2.7.1 What are New Roles/Practices**

Research findings suggest that the innovation activities conducted by academics, industrial managers and government officials are not something new comparing with the descriptions within the Triple Helix model. For instance, the university technology transfer office has traditionally been part of the business function within universities in terms of managing patent and intellectual properties. Carrying out in-house R&D activities is also an important business functions for big corporations.

What has been identified as new innovation practice in the region to the great extent is a reflection of government intention to enhance existing university-industry relations and encourage more technology transfer and commercialization projects between academics and regional firms in order to achieve economic growth. Changes observed during the study are evolving from the process of interactions between innovation actors rather than transformational. The new roles taken by the innovation actors to some extent reflect the strategic intention of creating knowledge-based innovation and expectations of innovation actors. Therefore, rather than using 'transformational relations' to describe the new patterns of innovation, 'transforming process' is what the region is experiencing as a result of practising new patterns of innovation. The key characters of such transforming process has been identified and summarized as below:



- In general, innovation actors are increasingly performing multi-roles in different situations. For instance, when a university professor discusses business with regional firms, he takes business role as the managing director of the spin-off company. However, he still takes the responsibilities of teaching and supervision within the university as an academic member of staff.
- Government intervention has been shifted from traditional command and control approach towards more facilitation and coordination by creating hybrid organizations such as 'government companies' or 'business-like government'. These organizations are designed to perform government policies whilst remaining business characters such as flat structures, flexible systems and task-driven managers so that they can better engage with industries to understand innovation needs.
- Universities are also becoming business driven by creating 'university business-arm' (i.e. a company with the university as the key share holder) whereas the traditional technology transfer office manages the administrative process and policy procedures related to technology transfer and commercialization.

Changes within regional firms in terms of participating in the new patterns of innovation are less evident throughout the research, which is in contrast to the high performance region. This is indeed a reflection of the innovation problem in less-developed region that the government wants to address by developing and implementing new innovation policies. Therefore to some extent the regional firms in this context are the object of government actions rather than active participants within Triple Helix networks.

#### **7.2.7.2 Challenges of New Roles**

What has become clear is that the new patterns of innovation is a reflection of the government effort in transforming the existing innovation system which is featured by loose coupled actors into a new innovation systems which is characterized by interactive networks, cooperation and continuous information flow among the key players of innovation, i.e. university, government and industry. However,

implementation of change takes time to have an effect and it cannot be done over night. Therefore, it is not surprising that various problems and concerns emerging from the transforming process of interactive innovation. Innovation actors within the Triple Helix networks are facing different challenges as a result of transforming into new roles.

First of all, significant concerns have been raised on the external orientation of universities in the commercial world. Universities have been traditionally seen as academic institution and the main role of a university is to provide high quality education and research. However, generating a good piece of research takes time and it is a long-term activity. Interview suggests that there are worries about the external orientation of universities and increasing commercialisation activities might have negative impact on the motivations of academics carrying out long-term science research. Secondly, for individual academic researchers who are actively engaged in applied research and commercialization activities, the dilemma is how to balance the role between carrying out business and being an academia. Whereas for academics who are thinking of setting up spin-off companies, the key challenge is that the traditional university system only reward scientifically acknowledged articles and reports. In addition to financial incentive, there is also lack of management training for academics who want to become entrepreneurs. Although within the university business school, there are various management courses available, it was felt that these management programme are too theoretical oriented and there is a lack of linkage between the management theory and the management training related to technology and innovation. What's more, for government officials taking the role as business manger and working between the institutional spheres, the key issues appear to be how to balance the public and private agenda.

### **7.2.7.3 Institutional Norms and Culture**

During the process of transforming to the knowledge-based innovation, values and culture changes are clearly evident at the strategic level in terms of creating new patterns of relationships within the regional innovation systems. The new values and norms are also supported by individual academics who are motivated by applied research and therefore actively involved in commercialization activities.

However, as innovation actors are trying to break through traditional borders, as indicated by the Triple Helix, the traditional institutional norms and values are either pulling innovation actors back to keep their traditional roles or creating constraints that prevent actors performing new roles. For instance, when the CoEs managers are trying to be more business-driven during the process of networking, the new roles are challenged by the management philosophies of partnership in the public sector which is featured by rules and regulations. Similarly, due to lack of incentive systems within the university, the concept of 'new entrepreneurial university' created by the Triple Helix theory is difficult to practise in reality.

Managing change in the process of innovation has been traditionally regarded as a positive measure for the effectiveness of innovation. There has been a tendency to equal innovation to change in the management and innovation literature. However observations and interviews from the research project indicate that change does not mean to re-establish the whole innovation systems and force everyone to accept new institutional norms and values. Improving the existing system rather than re-inventing the wheel is the central point of creating knowledge-based innovation. As one of the CoE managers indicated that some university professors are really good at doing science-based research and enjoy doing so. Given time and resources, they will make tremendous contribution in the relevant science and technology field. Therefore there is no point forcing them to go to the commercial direction. What is really needed is the institutional support and appropriate incentive systems to encourage and motivate those who are willing to do applied research and good at commercializing their research findings.

The key implication from research findings in terms of managing the transforming changes within Triple Helix is how actors involved in the innovation networks can keep balance between the new roles and traditional roles in order to develop new innovation practice, which is featured by cooperation and interactive networks.

### **7.2.8 The Context Matters**

So far the critical issues identified in relation to the cooperation, coordination and transforming changes within the Triple Helix have been examined and discussed.

What has become apparent is that the pre-conditions including traditional institutional

value and norms, the economic conditions within the region as well as the existing regional innovation system are playing an important role in shaping the results of the new patterns of innovation. Although the role of pre-conditions in creating knowledge-based innovation is implicit in Triple Helix, the importance of operational context in the collaborative environment has been emphasized by management researchers. The pre-conditions in this study can be distinguished at three levels: the strategic context, operational context and the historical context.

Firstly, the strategic context refers to the fragmented institutional relations and lack of interactions within the region, which has been addressed as one of the key barriers of creating knowledge-based region in Lambert report. Given the fragmented institutional culture within the region, it is not surprising that the CoEs which were designed created to create structural facilitations and improve cooperative relations within the region. However, due to lack of strategic consensus on innovation problem and the provisions of action lines, the implementation of the cooperative relations is challenged by the diversified interest and motivations as well as the underlying strategic agenda from innovation actors.

Secondly, it is important to understand that forming strategic relations does not necessary lead to the actual 'actions of collaboration'. As Stoker (1991) points out that whilst strategic context is important, it is often not the determine factor in decisions to cooperation. Cooperation is more properly seen as a respond to conflict, not the absence of it and the strategic context in fact provides a condition in which partners can work together to solve the conflicts. Research data indicates that the operational context consists of the content of the innovation tasks and the networking processes that innovation actors are involved. The operational context is also important because it not only reflects the complexity of tasks and activities performed by innovation actors, but also involves various skills linked to deal with various aspects of technology transfer and management process. Understanding the operational context of networking is important for innovation actors to decide on task priorities, information and resources required for implementation as well as establishing rules of conduct and means of interactions.

Effective operation of interactive innovation is also influenced by the fragmentation

of academic culture within the university. Due to the nature of academics and research is personalized and specific to individual interests, fragmentation of knowledge within the university is seen as one of the big barriers for creating shared values in terms of working in collaborative partnership context. It is observed that collective thoughts, active participation and commitments for joint effort are replaced by continues critics, arguments and diversified ideas. It could be argued that the benefit of criticalness and argument can certainly help to bring about wide issues of concerns from the academic communities. However the discussions of a broad interests and ideas need to be coordinated properly and directed towards the priorities and objectives of the innovation networks.

Improving knowledge fragmentation and internalization processes within the university is not an easy task as it is associated with wider interests of various academics communities and the government's long term education strategies. In addition, culture is not something that can be changed over night and it should be built into the long-term innovation strategy through continuous formal and informal means of interactions. Changing culture and value will accomplish little unless the impact of change is seen as an 'internal driver of opportunities' rather than 'external force'. Culture can be shaped through changing perceptions of actors involved by providing explicit information, clear objectives and operational plans, potential threat of not changes and investigated implementation issues and solutions.

Finally, the impact of historical context should not be underestimated in the process of creating knowledge-based innovation. Within the current study, the historical context refers to the traditional economic basis of North East region which is associated with shipping, mining and manufacturing industries, and the cultural context within the region. Although the CoEs were established to target five technology areas which are regarded as the research strengthens in the region, different views were raised concerning whether the five technologies are truly regional strengths or just used as an 'innovation instrument' for creating aspirations of knowledge economy where the regional wants to be. In addition, given the five technology areas also appear to be the strengths of the more advanced regions, the conditions that had helped to develop the advanced region are no doubt different from the North East of England. Although the same strategy can be adopted, the outcome is unpredictable due to different regional

conditions.

What's more, research shows that the cultural context is reflected by a lack of innovative and entrepreneurial culture within the region. For instance, the mindset of university academics is driven by public fund and pursue pure scientific research whilst ignoring funding available from private sectors to conduct applied research. This is because of the traditional university funding structure and the old regional innovation practice so that individual academics felt that effort in science research is more rewarded than doing commercial research.

### **7.2.9 Summary**

This section presented the key issues that need to be addressed during the implementation of knowledge-based innovation through Triple Helix relations of university-government-industry. The key issues identified are derived from three main perspectives: cooperation, coordination and transforming relations of innovation actors within Triple Helix networks.

Research findings suggest that the process of creating cooperative relations is far more complex than creating the physical infrastructure in the regional context. Although the CoEs were created attempting to address the existing institutional barriers of innovation through new ways of engagement with university, government and industry, empirical data shows the effort of forging cooperative regions is undermined by diversified interests, perceptions of different roles and underlying strategic agenda of different innovation actors. In addition, research data also revealed the challenges of coordinating complex innovation content and the dynamic innovation process. A number of coordination mechanisms identified during the networking process were discussed and the role of leadership in managing effective interactions was emphasized.

What's more, despite the claims of the transformational relations have emerged from the interactions between academics, business managers and government officials, research findings suggest that the nature of the changing relations is more transforming than transformational. In other word, it has been identified that innovation actors are still performing traditional roles as well as taking the new roles

during the process of interactions. Consequently, innovation actors are facing significant challenges during the process of change. The analysis of research findings also reveals that traditional institutional norms and values are still playing a key role in shaping the outcome of new innovation practice. Finally, the importance of pre-conditions for implementing Triple Helix is addressed with the focus on the strategic, operational and historical context within the region.

Creating knowledge-based innovation requires effective interactions between innovation actors in order to develop shared understandings and generating cooperation interests. As it is pointed by Morgan (1998), if knowledge creation is the ultimate aim of interaction, learning is the key process to achieve this aim. The next section will explore how learning is developed during the interactive networking.

### **7.3 Developing Learning Capacities within Triple Helix**

The capacities of learning in the regional context have been discussed from two perspectives Chapter 2. On one hand, learning is associated with organizational and individual ability to absorb new information as well as access to relevant resources including finance and expertise. On the other hand, the interactions within the innovation system also create an important knowledge infrastructure which can facilitate individual and organizational learning. During the process of knowledge-based innovation, it has been identified that the effectiveness of learning is influenced by the following key factors:

- Orientation for learning
- Orientation for interaction
- Orientation for commercialization
- Orientation for innovation

These factors are not only related to the learning capacities of individual actors within the Triple Helix networks but also linked with the whole learning system within the region. This section will explore the issues of learning identified during research and how these issues can be managed appropriately.

#### **7.3.1 Learning Difficulties**

The difficulties of generating learning capacities are learning are associated with a number of organizational and institutional factors during the process of interactions.

### **7.3.1.1 Organizational Learning**

From organizational perspective, learning difficulties are linked with two issues:

First, the dynamic content of innovation tasks and complex process of networking, which have made it difficult to identify the innovation needs within industries. The complex network structures and underlying individual interests and organizational agenda created significant challenges for learning in terms of accessing to relevant information, identifying key contact, managing priorities of innovation tasks to meet business objectives. In additions, inconsistency of networking strategy as a result of changing leaders within organization also caused difficulties to learn to adapt new rules of interaction and networking practice. The fast changing business environment also requires managers to respond to enquires quickly and effectively. However assessing and digesting information received from a variety sources takes time and skills to analyze and make high quality decisions. All these factors have hindered the processes of learning and understanding innovation needs within networks.

Secondly, working across boundaries within and between organizations has also created difficulties of learning in terms of sharing information and building common understanding on rules of interactions and institutional cultures and values.

### **7.3.1.2 Learning System**

In addition to organizational aspect of learning, challenges have also been identified in terms of creating a learning system within the region to reinforce interactive innovation for knowledge creation. The difficulties related to the system learning are generated in two ways:

The pre-condition of the region for creating the interactive innovation appears to be difficult due to the historical economic and cultural context within the region. The independent innovation actors within the system do not have the attitude for cooperation, or at least there has been lack of strategic congruence on how innovation capacities can be enhanced through cooperation.

There has been lack of motivation within the system in terms of encouraging more commercial-oriented research and industrial strategies for developing innovation and knowledge application.



### 7.3.2 Managing Learning for Knowledge-based Innovation

It is important that the learning difficulties identified in relation to creating successful knowledge-based innovation within the region need to be addressed within a broader organizational, institutional and regional context.

#### 7.3.2.1 Managing Learning System

In light of the issues discussed above, a number of suggestions on developing the capacities of learning for knowledge creation in the regional context are provided as follows. Table 7.1 illustrated the key factors associated with learning difficulties identified from the research and actions need to be taken by relevant actors.

Motivations for learning	Objects	Actions (Government Actor)
Orientation for learning	Industry	Identifying innovation needs
Orientation for interaction	University / Industry	Improving pre-conditions for cooperation and facilitating cooperation needs
Orientation for commercialization	University	Motivating more applied research
Orientation for innovation	Industry	Encouraging links between innovation and knowledge-based competitive strategies

Table 7.1 Managing Learning in the Regional Innovation Networks

Table 7.1 illustrates that managing learning for developing knowledge-based innovation needs to consider the underlying motivation of innovation actors in terms of orientation for learning, orientation for interaction, orientation for commercialization and orientation for knowledge application and diffusion within the Triple Helix networks.

Understanding the orientation for learning is important because it is the innovation needs within the industry that drives the need for new knowledge creation and learning. Managing the orientation for cooperation refers to the impact of pre-condition on the process of creating a learning culture. Therefore innovation actors need to facilitate the communications and information flow within the innovation system to create the conditions for establishing common interests. It should be

understood that having identified innovation needs is only one part of the innovation process, what is critical is whether there is sources for generating new knowledge, i.e. the academics attitude towards commercialization and willing to transfer ideas into industry. Creating an effective learning system needs to develop support mechanisms to influence and motive the research agenda in line with the innovation requirement from industries. Finally, encouraging more firms to innovate and creating knowledge are also critical for generating an interactive learning culture within the region. In this context, innovation should be considered in a broad context and linked with firm's strategy to create sustainable competitive advantages. Only when innovation becomes part of the management philosophy of region firms, can an effective learning culture been established within the region.

### **7.3.2.2 Managing Organizational Learning**

At organizational and individual level, managing effective learning also require innovation actors develop the skills and abilities to reduce the impact of uncertainties as a result of the dynamic changes within innovation networks. During the process of networking, innovation actors not only need to learn the content of innovation, which is usually related to the technology, but also needs to develop competence in project management skills, particular managing multi-projects and initiatives that are interlinked with each other. In this respect, developing social learning through continuous personal interactions and face to face contact are important to develop trust relations and establish shared understanding on common interests as well as institutional norms and values. The process of learning is essentially about information sharing and making sense of the information based on the context of operation.

Although social and informal ways of learning play a significant role in knowledge creation, the process of information sharing and creating cooperative relations between innovation actors particularly at organizational level requires formal institutional support, which can provide rules of interactions and clarify misunderstanding in terms of diversified interests and networking strategies. Only when the institutional values and norms within the new structure are well understood, can learning be effectively achieved. In addition, it should be noted that knowledge

has different natures, i.e. explicit and tacit. Mechanisms of supporting information sharing and enhancing learning should not simply treat knowledge as a final product as a result of interactions. It is the tacit knowledge accumulated during the process of interactions that leads to effective learning.

### **7.3.2.3 Managing Integrated Learning**

Fragmented partnerships culture and inconsistency of networking strategies have created significant challenges for managing learning during the process of interactions. Managing effective learning within the networking context require innovation actors to consider the overall impact of the innovation strategies on the regional development in the long term and the operational context as well as the organizational focus in relation to other actors within networks.

Knowledge creation needs time, resources and effort to cultivate relationships and innovation also needs entrepreneurial spirit to take risks and bear in mind of the unpredictable global market. Therefore, learning in the current innovation context should be understood as evolving process that is emerged from the demand of continuous changing in operational content, context and process.

### **7.3.3 Summary**

This section has explored the issues of learning identified during the process of creating the knowledge-based innovation in the North East of England. Two levels of learning difficulties have been addressed in relation to the organizational learning and system learning within the region. A number of contingent factors in generating effective regional learning system have been highlighted and mechanisms of support for enhancing organizational learning capacities have also been emphasized. Finally it has been pointed out that the needs for learning and the capacities to learn need to be regarded as an evolving process within the specific organizational, operational and regional context.

So far the discussions and analysis have been focused on examining the key issues emerging from the implementation of knowledge-based innovation in the North East of England and the theoretical implications in relation to the Triple Helix model. Based on the critical analysis of research findings, a model for effective

implementation of Triple Helix in a regional context will be developed and discussed in next section.

## **7.4 The Shaping of Effective Triple Helix**

### **7.4.1 Triple Helix: From Ideal to Feasible**

The Triple Helix relations of university-government-industry as a strategic framework for developing knowledge-based innovation, opens up new way of analyzing the process of knowledge generation and diffusion for economic growth. However the model is based on an ideal situation in which the common interests for developing knowledge-based innovation is shared by the key innovation actors (university, government and industry) within the Triple Helix networks. Please refer to Figure 1.1. Triple Helix model of university-government-industry. Based on this assumption, interactions take place across three institutional spheres with the willingness of cooperation and the common objectives for developing new knowledge.

However careful examination of the effectiveness and appropriateness of the implementation of the Triple Helix networks and the study of the innovation practice of the North East of England, which is traditionally regarded as a less-developed region, indicate that the common interests for knowledge generation and diffusion to the great extent is driven by the strategic intention of regional government for developing the knowledge economy. The cooperative relations were developed through the creation of the new organizational structures. The five CoEs were established as facilitators to encourage interactions between university, government and industry. With incorporation of the strategic context of the CoEs in the North East of England, figure 7.2a and 7.2b have been established to provide a visual aid for the understanding between the strategic intention (what was designed) and the reality (what actually happened) of the Triple Helix networks in the North East of England. Figure 7.1a illustrates the strategic intention of the SfS innovation programme whilst figure 7.1b presents the reality of new innovation practice against the expected policy outcome. The long broken line between the CoEs and the government demonstrates the non-cosy relationships between the two although CoEs was created in theory and founded by the regional government. Research findings indicate that the unique (private) nature of the CoEs and its self-contradictory both public and private aims

and objectives have left itself in a situation where its totality and legitimacy has been questioned by various stakeholders as well as the network partners within the region.

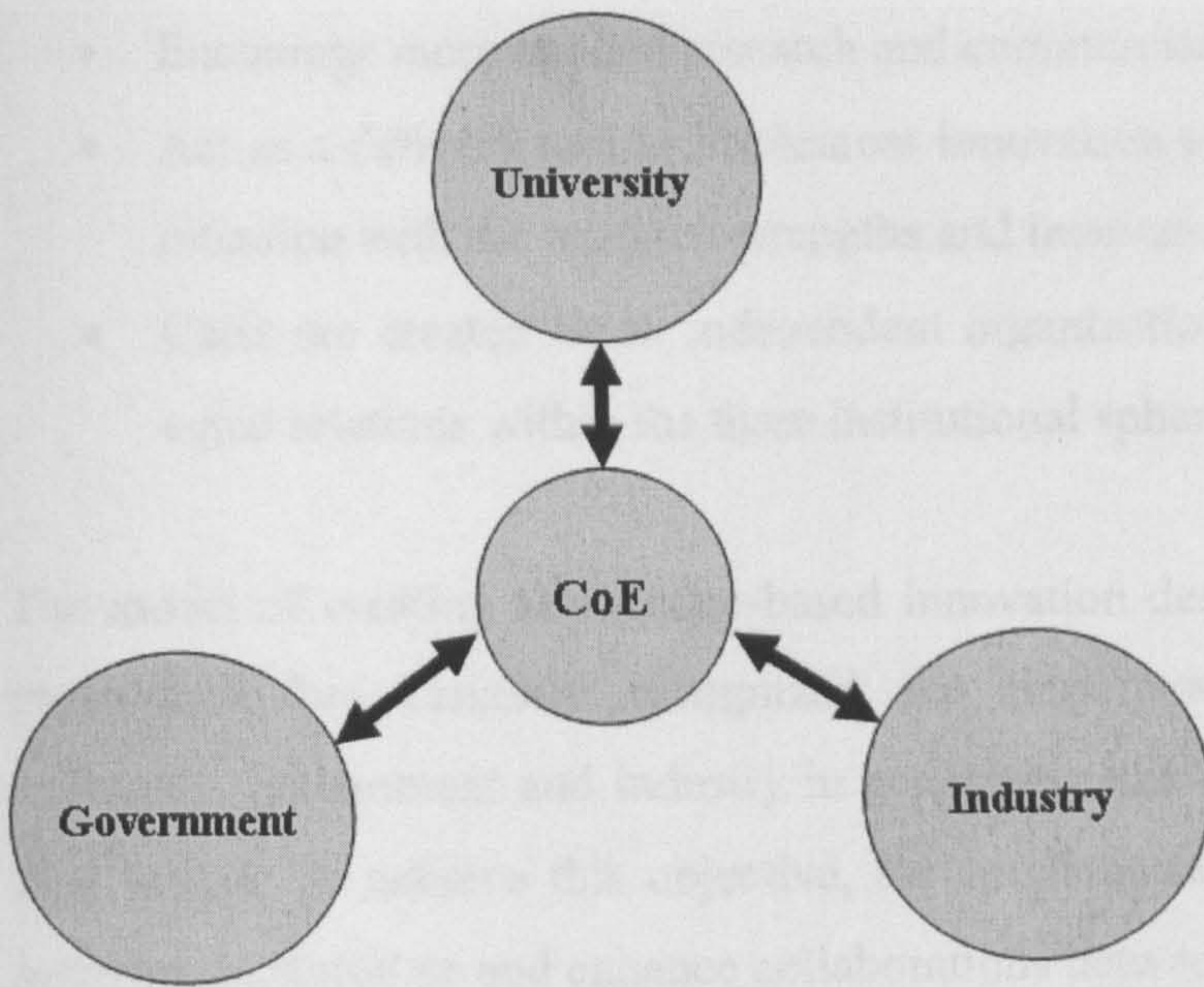


Figure 7.1a The strategic intention of Triple helix

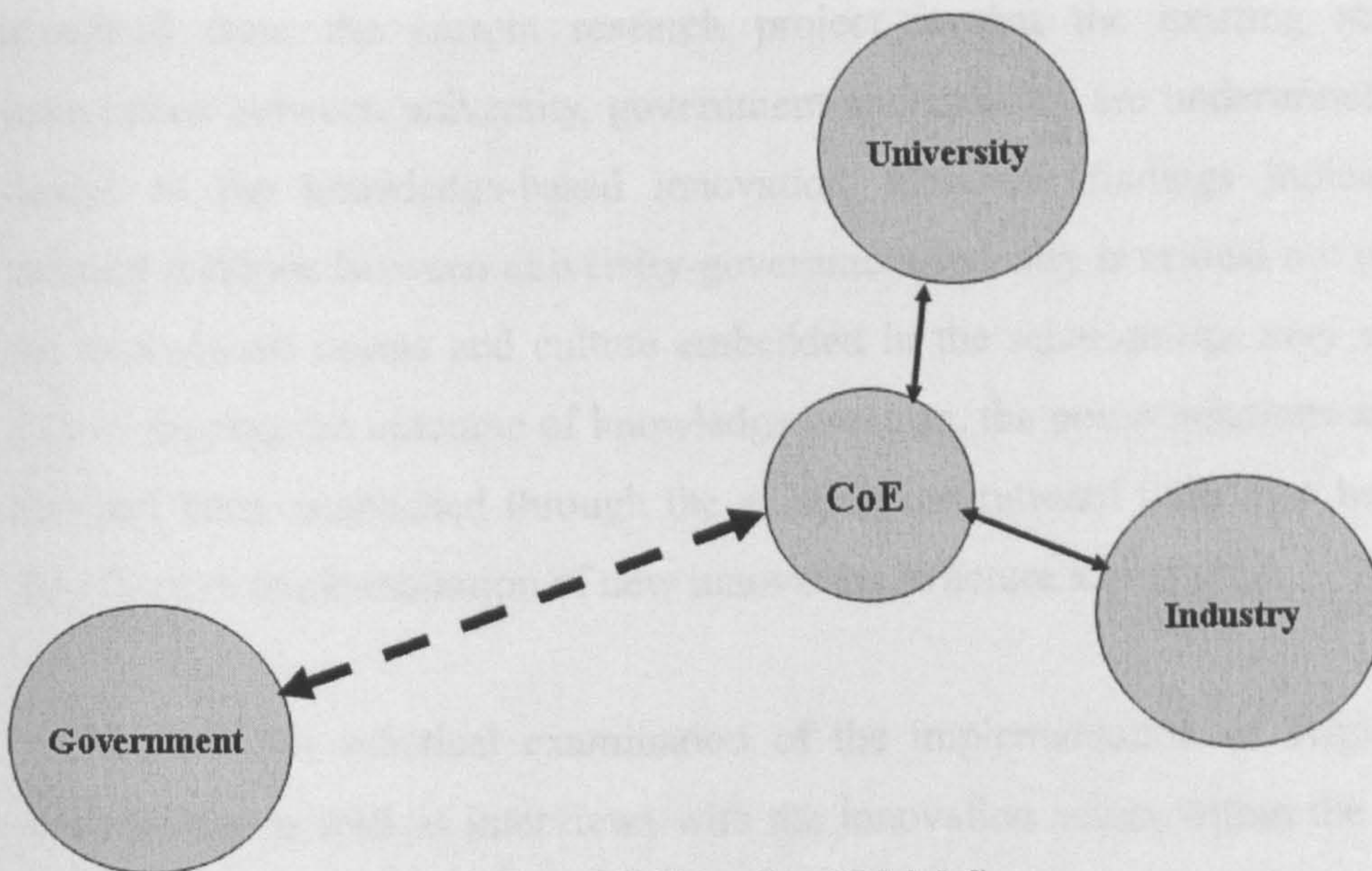


Figure 7.1b The reality of Triple helix

Figure 7.1a and 7.1b Contrast between the strategic intention and the reality of Triple Helix implementation

It is clear that from the policy point of view the main function of CoEs is designed as below:

- Identify the innovation needs from industry and feed back to the university to develop new product;
- Encourage more applied research and commercialize intellectual property;
- Act as a delivery tool to implement innovation policy and match the strategic intention with the research strengths and innovation needs of the region;
- CoEs are created as an independent organization and in theory should maintain equal relations within the three institutional spheres;

The model of creating knowledge-based innovation designed by the Sfs innovation programme has certainly recognized the importance of cooperation between university, government and industry in generating innovation capacities in the North East region. To achieve this objective, the cooperative structure is created with the intention to stimulate and enhance collaborations between research and application.

#### **7.4.2 Effective Model of Triple Helix in the North East of England**

However what has been implicit within the Sfs programme and in fact the key issue identified from the current research project is that the existing relations and interactions between university, government and industry are undermined during the design of the knowledge-based innovation. Research findings indicate that the existing relations between university-government-industry is critical not only because the institutional norms and culture embedded in the relationships play an important role in shaping the outcome of knowledge-creation, the power relations and networks that had been established through the existing institutional links also have hindered the effective implementation of new innovation structure and practice.

Based upon the practical examination of the implementation of Triple Helix and observations as well as interviews with the innovation actors within the Triple Helix networks, a more effective model of Triple Helix of knowledge based innovation has been developed during the current study as presented in Figure 7.3. The broken lines between university, government and industry highlight the existing interactions between the institutional spheres and the solid lines indicate direct working relations between the CoEs and the key innovation actors. It is within this new model of Triple Helix that the strategic value of CoEs in activating cooperation networks and mobilizing collective actions are highlighted.

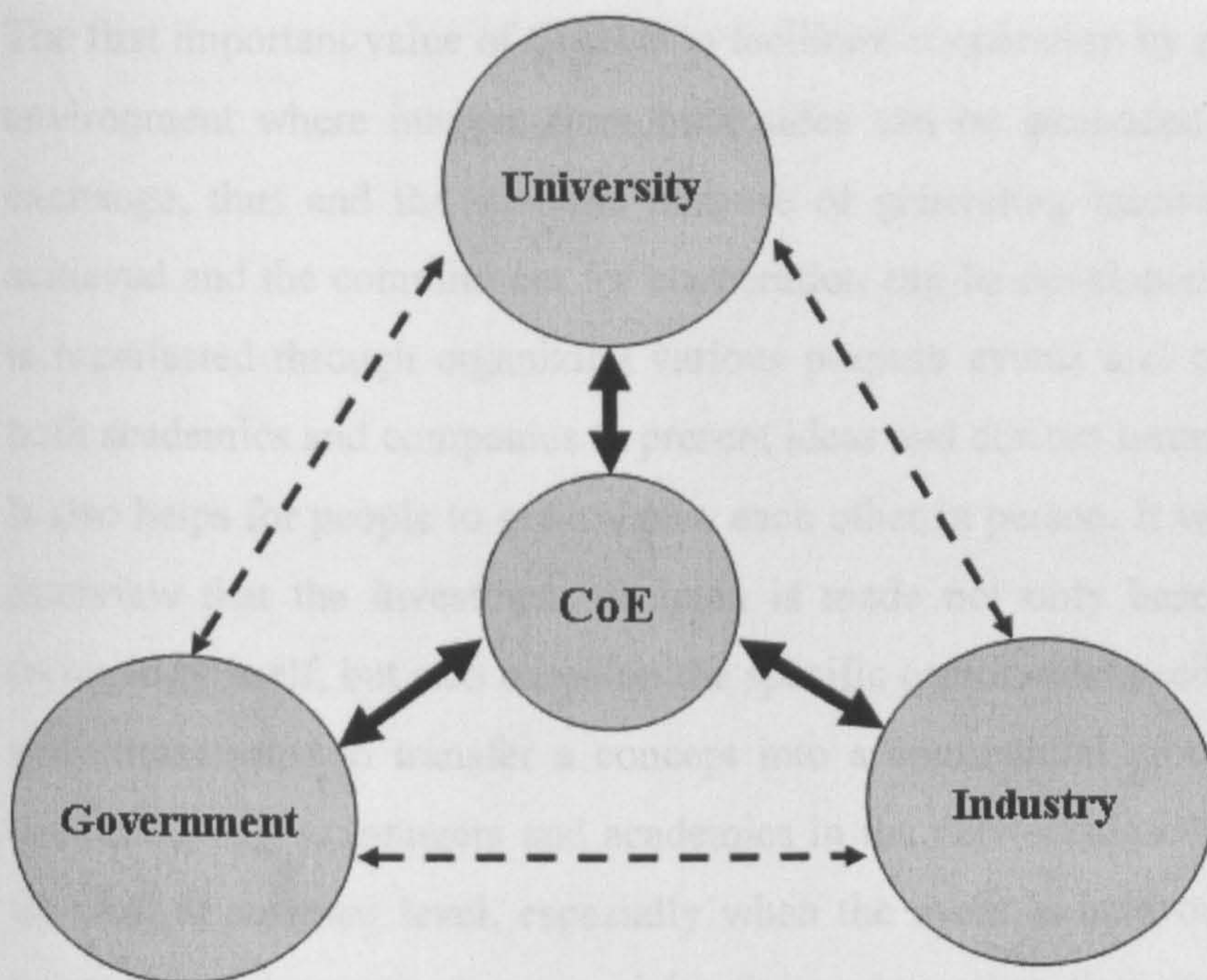


Figure 7.2 The effective model of Triple Helix in the North East of England

In the meanwhile, it is recommended that having recognized the strategic value of CoEs, the following points need to be taken into consideration:

- It would be more appropriate for CoEs to have quasi-government status or non-profitable position when established.
- The strategic vision and objectives of CoEs have to be agreed by the key stakeholders/innovation actors within the Triple Helix networks.
- A clear action plan for CoEs to engage with other innovation actors need to be provided.

#### 7.4.3 The Strategic Value of CoEs

The idea behind the SfS programme and the creation of CoEs is to enhance the innovation capabilities of the companies in the region and promote a natural coherent system of innovation between knowledge generation and knowledge application. The prescribed function for CoEs is to act as a 'knowledge bridge' to facilitate interactions between research (i.e. universities) and application (i.e. industry).

Throughout the study, a number of strategic values of CoEs have been identified:

## **Facilitating**

The first important value of CoEs is to facilitate cooperation by creating an interactive environment where interest from both sides can be generated through information exchange, thus and the strategic purpose of generating innovation projects can be achieved and the commitment for cooperation can be developed. The facilitating role is manifested through organizing various purpose events and conferences involving both academics and companies to present ideas and discuss issues of mutual concerns. It also helps for people to get to know each other in person. It was pointed out during interview that the investment decision is made not only based on the concept or technology itself, but also based on the specific person who needs to have willingness and enthusiasms to transfer a concept into a commercial product. The interactions between business managers and academics in the networking event also help to build up trust at personal level, especially when the event is held outside the region and people have chance to engage social activities as well as discussing business.

## **Brokering**

The second important value of CoEs is the brokering role within the innovation networks. The brokering role is different from facilitating in that it contributes to knowledge creation by tapping the utilizing the diversity of ideas, insights and solutions which are possessed by individual actors, within the networks in order to tackling the innovation problem. The brokering role of CoEs has been further explained through the process of implementing government funding scheme for problem solving or improving the condition for innovation. The role of CoEs is to identify the interest of individual actors and develop innovation project to solve innovation problems. Figure 7.4 illustrates an example of the broker role played by CoEs in terms of identifying potential interests of participants from both university and industries. It should be noted that the solid lines in the figure represent the formal interactions and communications between the actors whereas the broken lines indicate the informal interaction and communication in the between the CoEs and other innovation actors within the Triple Helix networks.



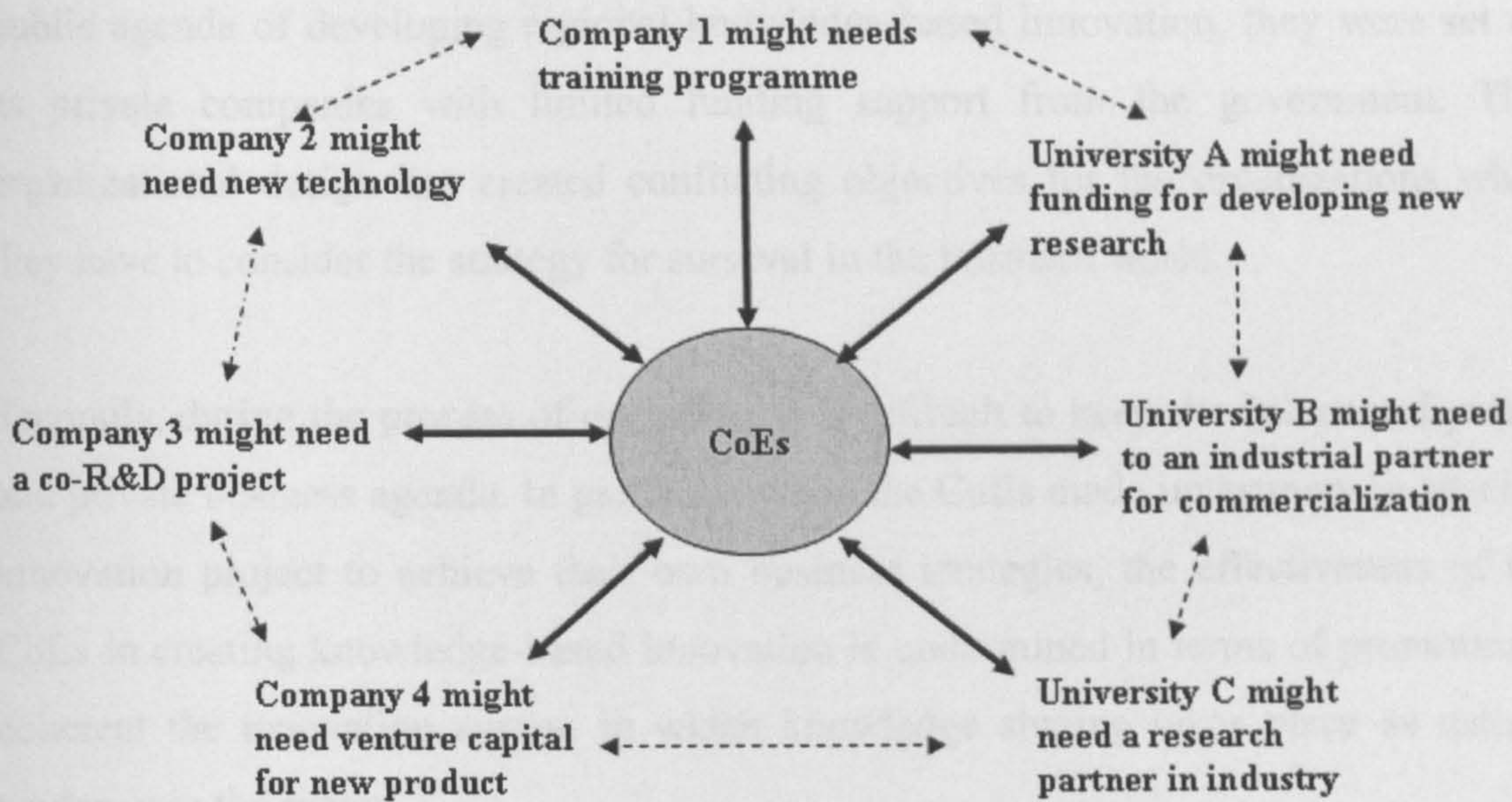


Figure 7.3 The Broker role of CoEs

### Mediating

In addition to facilitating and brokering the process of networking, the CoEs also act as mediator to provide continuous support in terms of maintaining communications and relationships in order to help information flow. For instance, the CoEs managers pay regular visits to individual companies and academics, disseminate updated policy documents and announce achievement through news release etc. to maintain network relationships with innovation actors. .

### Performing

Finally, it is important to understand that the CoEs not only helped to develop innovation networks and interactions between actors from university, government and industry, they are also involved in specific technology development project by offering management expertise and financial assistance.

#### 7.4.4 The Organizational Dysfunction

Despite the strategic value and active role performed by the CoEs, the new organizational configuration has manifested a certain degree of dysfunction due to the organizational design of the CoEs.

First of all, although the CoEs were designed as an independent organization with

public agenda of developing regional knowledge-based innovation, they were set up as private companies with limited funding support from the government. This organizational design has created conflicting objectives for the organizations when they have to consider the strategy for survival in the business world.

Secondly, during the process of operation, it is difficult to keep the balance of public and private business agenda. In particular when the CoEs made investment in specific innovation project to achieve their own business strategies, the effectiveness of the CoEs in creating knowledge-based innovation is undermined in terms of promoting a coherent the innovation system in which knowledge sharing takes place as natural tendency in the region.

In addition, because CoEs have to consider its own organizational strategies and business priorities, the innovation networks established by the CoEs may not have necessarily reflected the interests and needs of other innovation actors within the region. Observation shows that there is a tendency of creating CoEs centered innovation networks in relevant technology areas and the legitimacy of CoEs in leading the knowledge-based innovation have been questioned by interviewees from the university and industries.

#### **7.4.5 Summary**

An evaluation on the Triple Helix relations within the SfS innovation programme and the organizational design have revealed a number of critical issues which are fundamental to the implementation of knowledge-based innovation strategies. Despite the strategic values presented by the new organizational structure, the impact of organizational dysfunctions are also significant in terms of creating cooperative relations, coordinating the process of interactions and managing the transformational changes within the Triple Helix relations of university, government and industry. The dynamics and challenges facing innovation actors during the process of networking will be discussed respectively in the following sections.

## **7.5 A Strategic Framework of Implementing Knowledge-based Innovation**

One of the important objectives for this research project is to establish a conceptual model which provides the innovation actors with practical guidance for creating knowledge-based innovation through Triple Helix in the regional context. As it has been discussed in Chapter 1, although the Triple Helix highlights the importance of interaction and social process in supporting knowledge creation between the key actors within the innovation system, to some extent the TH model fails to further explore and clarify the implementation strategies when it is applied in the regional context.

In addition, the model was developed in the context of high performance region in itself embodies an important implications of the pre-conditions in constructing the Triple Helix relations of university-government-industry. It is no doubt that learning from the best practice developed within the high performance is an important starting point for less-developed regions. However, research findings clearly indicate what cannot be copied is the pre-conditions that are associated with the particular geographical, historical and institutional factors within the high performance region. What's more, although the institutional interactions addressed in Triple Helix model plays an important role in stimulating cooperative culture which can encourage knowledge sharing within the system, empirical data collected from the research project shows that the micro dynamics of interactions and the processes of networking are underestimated.

Based on research findings and analysis, a strategic framework for implementing Triple Helix in a regional context has been developed as illustrated in figure 7.4, which has taken into considerations of the key factors and processes of innovation networking and knowledge sharing identified during the research.

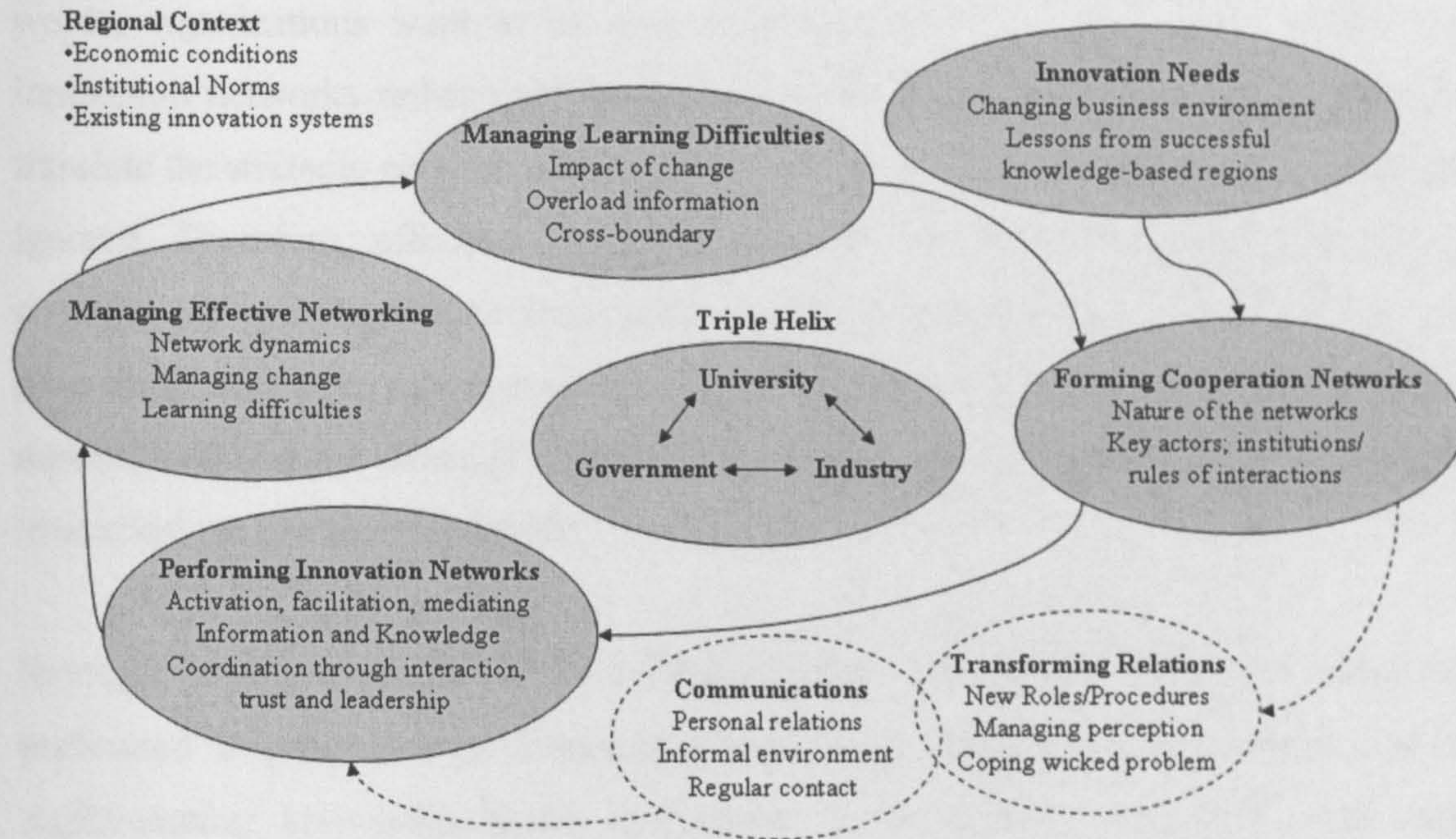


Figure 7.4 A strategic framework of implementing Triple Helix model of knowledge-based innovation in a regional context (Implementation Model).

The implementation model of Triple Helix is designed to address the key processes and factors that are shaping the meaning and dynamics of knowledge-based innovation at regional level. The model starts by addressing the external forces in driving the needs for change and creating knowledge-based innovation, which then leads to the formation of policy networks to improve communications between innovation actors and create structures in order to facilitate and enhance cooperation between innovation actors. However, forming cooperation structures does not necessarily lead to collective actions and knowledge flow within the networks. Issues related to how strategic congruence is achieved in creating the cooperative relations need to be understood and different institutional agendas and interests within innovation networks also need to be shared during the process of network formation.

Traditional policy implementation tends to assume that cooperative actions will follow after policy networks have been established. The underlying assumption of the linear approach of implementing innovation policy is that knowledge-based innovation can be designed and managed by the establishment of policy networks. Due to different perceptions and strategic intentions, the agreed common goal is often a representation of the aspiring future rather than agreed action lines. The real strategic intentions and blockages are actually hidden under the cooperation umbrella. In other

words, organizations want to be seen as participative and cooperative within the innovation networks rather than having real commitment for taking action. How to translate the strategic networks into specific objectives and workable plans tends to be ignored. Therefore, effective implementation of innovation networking needs to consider the process of how innovation actors are transforming into new roles and how these new roles are communicated with partners through social and informal networks so that the strategic intention can be shared between network partners and trust relations can be established.

Strategic intention can never be achieved unless actions are taken and tasks are performed to get job done. Performing innovation networks is the central part of implementing knowledge-based innovation. It is at the operational level that institutional and individual relationships are translated into concrete projects so that knowledge can be created and diffused. Effective networking does not only depend on the ability of network facilitators to elicit and mobilize resources for developing new projects, but also depends on the complexity of the tasks itself and the extend to which the conditions for cooperation is provided within the operational context. These conditions may include scarce resources, divergent interests of innovation actors and organizational provisions for adapting new rules of interaction. In addition, effective implementation of innovation networking also needs the appropriate skills and method to manage the network dynamics as well as coping with learning difficulties within the networks, particularly the learning difficulties coming from the tensions and institutional uncertainty as a result of the new organizational arrangement within the networks. Finally, it is important for the challenges and concerns emerging from the process of implementation to be feedback to policy makers who can then incorporate the issues into new innovation policy processes for further development of regional innovation strategy.

## **7.6 Conclusion**

The Triple Helix model suggests that in order to be effective in creating knowledge-based innovation, innovation actors such as academics, industries and government need to interact and work closely to share information and develop collaboration projects. However, close examining the implementation of the knowledge-based innovation strategy in the North East of England reveals that the Triple Helix model is

facing several challenges.

First of all, the assumption of cooperative conditions within Triple Helix relations of university-government-industry has been challenged by the diversified institutional, organizational and individual interest and agenda. Despite the creation of the cooperation structure through the new organizational configurations, research findings indicate that lack of strategic congruence on the process of creating knowledge-based innovation has led to a more fragmented rather than cooperative institutional relation.

Secondly, by examining the coordination process within Triple Helix, it has been identified that innovation actors are facing significant challenges exposed by practicing new patterns of innovations and managing the dynamic innovation content, processes and complex network relations. The dynamic micro-process of implementation has challenged the Triple Helix in a sense that the outcome of knowledge-based innovation is not driven by the strategic intention, but to the great extent influenced and shaped by processes of building and maintaining innovation networks. In addition, the nature of the changes during the process of implementing new way of innovation has also been identified as 'transforming' rather than 'transformational' in the sense that innovation actors are playing two roles during the new ways of engagement. The role of pre-conditions for knowledge creation has been addressed as a critical issue that has been underestimated within Triple Helix model and the importance of learning to create the conditions for cooperation within the regional context has been explored and how to manage effective learning has been discussed.

Finally, the chapter closed by presenting the strategic framework of implementing Triple Helix knowledge-based innovation which incorporates the key issues identified in the process of creating knowledge-based innovation networking. The implementation model also elaborates how the strategic intention can be translated into various stages of networking processes.

The final chapter (Chapter 8) will synthesize the research findings and present the overall key argument emerging from the research.

# Chapter 8 Conclusions and Recommendation

## 8.1 Introduction

The main purpose of the study has been to investigate the process of creating knowledge-based innovation in the less developed region. The opening chapter of the thesis highlighted the strategic context of knowledge-based innovation as a result of the increasing trends of creating knowledge economy, developing interactive innovation through networks and regional focus of knowledge creation. These developments are placing increasing pressure than ever on government as well as firms to become more dynamic and responsive to innovation and knowledge creation. Therefore having examined the process of how knowledge-based innovation strategy is implemented in the North East of England through the development of interactive networks and collaborations between university, government and industry. This chapter presents the conclusion of the study and recommendation for further research.

Chapter 1 provided the overall literature view on the meaning associated with knowledge-based innovation and models related to the creation of knowledge-based innovation with a particular focus on examining the strategic importance of Triple Helix in creating knowledge-based innovation. Chapter 2 further investigated implementation issues relating to the success of Triple Helix and outlined the critical issues emerging from the implementation, which is followed by a detailed outline of the research design and case study strategy in Chapter 3. The overall case study is presented in Chapter 4, 5 and 6 through presenting the background of innovation strategies in the North East of England, the pilot study and the main study findings from the research. The implications of these findings were analyzed in Chapter 7 with focus on the examining of the effectiveness of implementing knowledge-based innovation through Triple Helix networks.

This chapter begins by re-examining the research aims and objectives set up at the beginning of the thesis and highlights the key outcome of research project, which is followed by synthesising the salient findings of the research and the implications of research. The contribution to knowledge will be addressed through the outline of the theoretical and practical contributions as well as policy implications. Finally, the

chapter will finish with an insight into the future development of knowledge-based innovation and suggestions for further research.

## **8.2 Reflections on Research Objectives**

The research aims and objectives were stated in the Introduction Chapter and four main objectives were presented in table I. An in-depth literature review was carried out and presented in Chapter 1 and 2 and the research problems and key areas that require further research were recognized and addressed. The purpose of this section is to reflect on the achievement of these aims and objectives.

The overall aim has been achieved throughout the thesis by exploring the process of implementing knowledge-based innovation at the regional level.

*Objective 1: To establish a theoretical framework for implementing knowledge-based innovation by critically examining the propositions of Triple Helix.*

This objective has been achieved through the careful examination of the existing literature on knowledge-based innovation with particular reference to the strategic framework of Triple Helix.

*Objective 2: To identify the nature and process of regional innovation through a pilot study.*

The pilot study was designed for the purpose of understanding the nature of innovation networks and identified general issues emerged as well as challenges facing innovation actors. The author examined the implementation and networking process of inward investment strategy, which is one of the key functions for creating knowledge-based innovation in the North East region. Preliminary findings were presented in Chapter 5 with discussions and implications for further developing research questions during main study. By analyzing the evidence from pilot study, an understanding was gained of the dynamics and challenges of implementing regional innovation networks and the key issues related to managing effective interactive innovation in the regional context.



*Objective 3: To examine the effectiveness of implementing the Triple Helix model of knowledge-based innovation through the main study.*

The effectiveness of implementing Triple Helix networks has been critically examined through the main study of how the strategic intention of creating knowledge-based innovation is translated into practice within the SfS innovation programme in the North East of England. The main findings and key issues have been presented in Chapter 6 with particular focus on the cooperation, coordination and key challenges involved during the process of implementation.

*Objective 4: To establish a conceptual model for developing knowledge-based innovation at the regional level based upon the critical analysis and synthesis of research findings.*

Based on the evaluation of implementation process of Triple Helix networks, the totality of the Triple Helix model has been challenged and addressed with reference to the critical issues identified during the current study and a strategic framework of implementing Triple Helix model of knowledge-based innovation in a regional context has been established in section 7.5.

In sum, the overall research aims and objectives have been achieved. The research strategy has provided a rich set of empirical data and the analysis and findings have advanced the knowledge in understanding the dynamics of knowledge creation and provided a detailed insight into the interactive networks of Triple Helix relations between university, government and industry in creating knowledge-based innovation.

### **8.3 Synthesis of Overall Findings**

The overall findings suggest that new patterns of innovation within the Triple Helix networks is not something new, rather it should be regarded as a strategy of further strengthening existing innovation practice and exploring new innovation opportunities by creating new ways of interactions.

The strategic value of Triple Helix lies in its emphasis on the importance of cooperation between the key players of developing regional economy: university,

government and industry in terms of enhancing the linkages between knowledge generation and knowledge application with infrastructure support and policy facilitation. The concept has certainly offered significant values in terms of generating new patterns of innovation and stimulating cooperation in less developed regions which are thriving for economic growth through knowledge creation.

Given the core elements (university, government and industry) and key conditions (cooperative relations and interactions) addressed within the Triple Helix for creating knowledge-based innovation, the question is how the strategic intention can be translated into reality through developing effective cooperation and interactions between university, government and industry. The remainder of this section will answer this question by outlining the key findings have emerged out of the analysis of research findings.

### **8.3.1 Importance of Structural Facilitation**

The cooperation issues identified from the research highlighted the importance of creating a purposeful organizational structure to facilitate communication and forge cooperative relations between innovation actors. The significance for creating structured facilitation lies in a number of strategic and operational factors.

From strategic perspective, structured facilitation through new organizational configuration provides a focused approach for implementing knowledge-based innovation in terms of identifying and incorporating diversified interests of innovation actors and providing channels of communications to develop common interests for collaboration. The structural facilitation on one hand helps to generate new contacts and links for innovation, on the other hand, it can help to maintain and improve existing communications within innovation networks. In addition, implementing innovation policy requires collective actions and the new organizational configuration can bridge links between innovation actors and tap different resources together for new knowledge creation.

However the structural facilitation is neither blind, nor it can be created without the strategic congruence of various stakeholders, the appropriate institutional support and interactions of innovation actors. The cooperation issues identified from the research

demonstrated that the new organizational structure was perceived in different ways by innovation actors with different strategic agenda. As a result, the effort of creating a cooperative culture through structural facilitation was undermined and a certain degree of organizational dysfunction occurred.

Research findings also indicate that the nature and identity of the new structures need to be clarified so that the implementation of new innovation practice is supported by organisational and institutional legitimacy. As it was presented in figure 7.1a and 7.1b that despite of the government intention to create an independent organization acting as facilitator between university, government and industry, the way that CoEs were established as private companies led to the disparity and non-cosy relations between the CoEs and the government which affected the effective implementation of knowledge-based innovation strategy. What's more, the structured facilitation helps to enhance social interactions through brokering and mediating between innovation actors. The personal networks developed through structured facilitation are clearly evident in terms of information flow and establishing interactive networks based on mutual understanding and common interests.

Finally, without underestimating the role of informal networks in facilitating knowledge sharing, the structural facilitation provides a strategic way of developing purposeful networks and prioritising innovation tasks for knowledge creation. If cooperation within Triple Helix is considered as an important condition for developing knowledge-based innovation, findings from the research project have demonstrated that the strategic value of the new organizational configuration is to create the condition for cooperation through the process of facilitating communications and forging innovation networks.

### **8.3.2 Strategic Leadership in Triple Helix Relations**

The second theme focuses on the role of strategic leadership in coordinating the dynamic network relations within the Triple Helix networks.

Although the Triple Helix framework has provided the strategic direction of creating knowledge-based innovation through partnerships between university, government and industry, the model provides little practical guidance on how the partnership

relations should be coordinated with the Triple Helix networks. Most importantly, the role of strategic leadership remains vague in terms of how innovation actors are motivated and facilitated to collaborate and maintain effective networking relations.

Despite of a lack of clear indications on the strategic leadership within Triple Helix, the increasing trends in addressing the role of university in the knowledge economy has oriented to a view of academic-led knowledge-based innovation, which is inspired by the evolution of 'entrepreneurial university' (Etzkowitz, 2004) and other studies of linking university with economic growth (William Z. Todorovic et al., 2005, Lazzeroni and Piccaluga, 2003, Vogel and Kaghan, 2001).

However what has been identified in this research project is that the strategic leadership of creating knowledge-based innovation is strongly influenced by government intentions of creating regional knowledge economy. Although the university as the key player of regional economy is regarded as an independent partner of government within the Triple Helix networks, research findings suggest that the exercises of the strategic leadership is hindered by the loose coupled partnerships between university, government and industry. The difficulties of creating an effective strategic leadership within the Triple Helix are derived from a number of perspectives:

First, the meaning of the partnerships between university-government-industry is unclear and implicit. In another word, there is lack of shared vision within partnership networks. Although the CoEs were created as an elaboration of common interest of university, government and industry, there is no clear operational guidance on how the functions and roles of CoEs are linked to other actors within the innovation networks. This left the CoEs in a difficult position in justifying its actions during the implementation of innovation tasks. Secondly, exercising leadership role within the partnership context requires the leader take a neutral position and act on behalf of the interests of network partners. However the fact that the CoEs were created with both public and private objectives left itself in a dilemma where the legitimacy of leading innovation tasks has been questioned by network partners.

What's more, the implementation of leadership is also affected by a lack of concrete support and commitment from institutional leaders in terms of facilitating communications within and between institutions. Partnership has been regarded as a

means of negotiating legitimacy for funding rather than creating real collaborations between innovation actors. Finally, the implementation of strategic leadership is further challenged by the complexity of innovation content and dynamic innovation processes at different levels across institutional boundaries.

The challenges of implementing strategic leaderships within Triple Helix indicate that partnerships will remain as loose coupled independent actors if there is lack of effective leadership to coordinate and direct the networking effort of innovation actors. However, creating the leadership position does not in itself lead to the participation and commitment of innovation actors. Creating an effective leadership within Triple Helix networks requires efforts being placed in the following areas:

- A clear defined innovation strategies that incorporate the strategic intentions of key innovation partners;
- The functions and roles of the leaders need to be agreed and approved by innovation partners.
- The interest and roles of the leader need to reflect rather than conflict with the interests of innovation partners.
- Communications and interactions between innovation actors within the partnership networks need to be supported by the institutional leaders within the innovation networks.

Finally, it should be pointed out development of effective strategic leadership within Triple Helix not only needs institutional arrangements in terms of establishing clear rules of interactions, but also requires the commitment of institutional leaders to be open about individual strategic agenda and real organizational situation so that the partnership relations can be established based on real interest to solve innovation problems.

### **8.3.3 Pre-conditions for Effective and Appropriate Implementation**

The third key theme emerging from the overall analysis of the case study is the impact of pre-conditions on the appropriateness and effectiveness of Triple Helix implementation.

The theory of Triple Helix implies that it is the cooperation between university, government and industry that lead to the success of knowledge-based innovation and economic growth and innovation. However the narratives of Triple Helix are derived from high performance regions with strong industrial clusters and cooperative culture conditions. Although the cooperation structure within Triple Helix can be design, as it has been demonstrated in the research findings, the conditions and operational context in which these innovation activities are performed cannot be imitated. The pre-conditions include strategic, operational and historical context which play a significant role in shaping the outcome of implementing Triple Helix knowledge-based innovation strategy. The strategic, operational and historical contexts are manifested through different institutional norms and values, fragmented regional culture and historical economic conditions within the region.

The conflicts of institutional norms and values are manifested from a number of perspectives. For instance, companies are under pressure of fast changing market and diversified customers needs therefore are likely to be outcome-driven. Whereas academics in the research environment tend to be process-oriented due to the nature of research is about critically evaluation of various options and exploring the new ways. During the research process, interests are likely to be shifted towards new directions and influenced by emerging findings and results. Therefore appropriate strategy to manage and match the values from both sides needs to be developed. From this perspective, the role of CoEs in facilitating the understanding of difficulties and priorities from both sides is significant. This is partly due to the fact that many CoEs managers themselves used to be academics in certain field of technology and after several years of working in the commercial environment, they have also developed knowledge and understanding on the pressure from the competition of the market. Therefore the CoEs managers can help to negotiate appropriate solutions which take into account concerns from both parties.

The fragment institutional culture has also led to the difficulties for developing collaboration projects at operational level between innovation actors. The institutional actors within the region are driven by individual strategic and political agenda. Although a vague cooperation vision is established through forming the loose partners, the problem of lack of shared vision, difficulties of 'internalization' through

effective communications and commitment of institutional leaders have led to the disparity of cooperation agenda, hence the effective implementation of knowledge-based innovation at operational level is affected.

In addition, the willingness of innovation actors to participate innovation networks has also been identified as an important issue for knowledge creation and diffusion. This is partly due to that the strategic vision of creating knowledge-based innovation through Triple Helix cooperation has not been effectively translated into clear objectives and action plan. The impact of the new patterns of innovation and benefit for individual innovation actors also has not been shared within the networks. As a result, the ambiguity and uncertainties created during the process of interactions have led to misunderstandings and different perceptions on the strategic roles played by innovation partners within the Triple Helix networks. For instance, the global focus of university in raising research profile and developing international reputation as a leading research institution does not necessarily contradict with strategy of establishing local partnerships and business networks with industry and government. In stead, the global outreach and the international contacts help to attract and retain leading scientists and researchers to work within the region in the identified science and technology innovation programmes and create university spillovers. The theory of localization suggests that the key impetus determining the strategic location of R&D firms is the knowledge spillovers from the local university based on the research excellences (Dalum, 1995, Knight, 1995, Jaffe A.B. and Trajtenberg M. and Henderson R., 1993). Therefore the effects of the global orientation of university have on creating knowledge-based innovation in a regional context are arguably positive rather than negative. What needs to aware in terms of managing effective innovation within Triple Helix is the design and implementing the appropriate communication strategies between innovation partners between university, government and industry in the process of interaction.

Understanding the dynamics within the institutional, operational and economic conditions within the region is important for the effectiveness and appropriateness of implementing Triple Helix networks. However, it should be noted that the pre-conditions which are associated with institutional culture, norm and value can not be changed over night. Rather, these conditions can only be influenced and shaped

through the continuous interactions between innovation actors at strategic, operational and individual levels.

### **8.3.4 Managing Transforming Process**

The final theme focuses on managing the changing roles during the transforming process of Triple Helix for creating knowledge-based innovation.

The strategic value of Triple Helix lies in its emphasis on the cooperation between knowledge generation (university researchers), knowledge facilitation (government support) and knowledge diffusion (industrial application). As the process of knowledge-creation and commercialization is neither simply supplier driven, nor demand driven, rather it is a mutual shaping process through the interactions between university, government and industry. In order to interact effectively, it is important for actors to fully understand and appreciate the role played by others and work across boundaries. Working across organizational and institutional boundaries has inevitably created new roles and responsibilities for innovation actors.

Empirical evidence also clearly suggests that the boundaries between research, industry and government become blurred with the innovation activities are increasingly conducted between the organizations rather than within an individual organization. For instance, academics are funded by government to be based in industry doing applied research projects. Companies also send experienced R&D staff to use university facilities for testing facilities and developing protocols. Government agencies act as business broker and consultant for university and industries. New ways of engagement has led to the requirement of reassessing existing roles played by innovation actors in order to evaluate the extent to which innovation capacity is generated and developed through the interactive networks in the region.

Innovation requires entrepreneurial spirit which implies quick decision-making, responsive and flexible, focusing on prioritise and project driven. The effort of developing entrepreneurial spirit for innovation within the region is particular evident from academics taking industrial research, establishing spin-off companies as well as government attempt of creating business-like organizations to promote innovation activities. However, research findings suggest that changes emerging from new



innovation practice are more transforming rather than transformational due to a number of institutional and organizational constraints within the new context of innovation. Innovation actors playing multi roles are facing a number of challenges.

One of the key challenges facing CoEs in performing government policies, as it was demonstrated in Chapter 7, is the public perceptions on traditional government functions. Although it is clear that CoEs as the facilitator of new process of innovation, is to work with academics and industries within the Triple Helix networks to identify innovation problems and generate new knowledge. The traditional image of being a public-created organization has made other innovation actors believe the CoEs are created to provide effective service for network partners. In addition to the traditional perception of government function in developing regional innovation, the self-contradictory objectives of both public and private that the CoEs have to meet further constrained the effective networking during the process of interaction.

Another challenge facing innovation actors in performing new roles is that there has been lack of incentive support and clear performance indicators to encourage new patterns of innovation practice. For instance, in the university context, academics are still rewarded by publishing papers and allocating research funding. Academics taking the new role of being entrepreneurs are facing the challenges of managing both research and teaching as well as conducting business activities. In addition, the performance within public sector based on the number of jobs created within the region also does not provide sufficient incentives and supporting systems for managers from government organizations to actively engage with private sectors and generate new innovation projects.

The dilemma of changing roles during the process of performing new innovation practice has left with the question of how innovation actors manage the process of transition and the balance between traditional and new roles. Research findings indicate that managing the transforming process of Triple Helix requires the development of an effective learning system which provides an environment that is conducive to knowledge sharing and interactions between innovation actors so that the new culture and roles can be understood and shared to perform new patterns of innovation.

### **8.3.5 Summary**

The thesis started with an overview of the shift of paradigm towards knowledge economy as a result of the changes of global business environment and the need for developing innovation based on knowledge creation. Increasing attention has been paid on the geographic dimension of innovation which plays an important role in provide an environment conducive to collaboration and interactions between innovation actors. The Triple Helix model of knowledge-based innovation has placed university at the heart of the knowledge creation, and calls for broad interactions between university, industry and government for collaborative innovation.

However moving into the new patterns of innovation requires developing new cognitive map to understand the changes, practice and dynamics involved in creating knowledge-based innovation. The dynamics involved in implementing Triple Helix networks means that a more social and organizational dimension of innovation needs to be developed to in order to enhance the understanding on how the strategic intention of creating knowledge-based innovation can be translated into operational practice. In addition, the micro and social process of analysis of knowledge creation will complement existing field study on knowledge-based innovation theories.

In conclusion, this section has succeeded in addressing the key themes emerged from the case study and were closely related to the effective implementation of Triple Helix model of knowledge-based innovation in the North East of England. The Triple Helix networks to the great extent focuses on the strategic and policy intention of creating knowledge-based innovation at macro level. There is lack attention paid on the implementation of Triple Helix in a specific regional context. In the light of the analysis within the thesis, it could be argued that although Triple Helix can be designed, the dynamics involved the process of implementation needs to be appropriately addressed and managed. The effectiveness of knowledge-based innovation requires redefining the strategic intentions and roles of innovation actors within Triple Helix networks and developing the appropriate action so that innovation problems can be addressed for the success of knowledge creation.

## **8.4 Contribution to Knowledge**

Triple Helix, as a heuristic concept emerging from the dynamic knowledge economy, has certainly offered strategic value that reinforces the understanding of the importance of university-government-industry relations in generating knowledge-based innovation. However, empirical evidence from the research indicates that the totality of the Triple Helix concept is facing challenges in practice and needs to be further validated in a much wider context. The distinctiveness of this research lies in contributing to the existing theories of Triple Helix by highlighting the importance of redefining the strategic intentions and roles of key actors in building up knowledge-based innovation. The research findings also have significant implications for government policy makers, business practitioners and university academics when addressing the existing deficiencies in the implementation of knowledge-based innovation strategies in the regions. This may enable innovation actors to think beyond Triple Helix, taking into consideration the pre-conditions, institutional dynamics and complex networking processes for the success of knowledge-based innovation. Future research is suggested to investigate Triple Helix networks during the implementation of the new knowledge-based initiative - Science City in the North East of England.

### **8.4.1 Theoretical Contribution**

Overall, the research has to some extent challenged the totality of Triple Helix model in its overemphasizing the strategic intention of the stakeholders and the neglecting of the practicality and pre-conditions of implementation issues in the following ways.

- The assumption that economic growth can be achieved through the design of cooperation between university government and industry has been challenged. The overall findings have demonstrated that the cooperative relation is an evolving process emerging from the dynamic interactions between innovation actors rather than a cautious design of new organizational structures.
- The assumption that common interest for developing the regional economy is the key driver for university-government-industry cooperation has not been identified within the research project. In stead, the motivation for

collaborations between academics, regional firms and government is driven by diversified interests, roles and strategic agenda of different individuals and organizations within the region. Research findings indicate that Triple Helix networks to the great extent is a strategic tool adopted by the government to enhance regional innovation capacities by enrolling key players in the region for knowledge generation and diffusion. The strategic intention for creating knowledge-based innovation therefore is redefined during the process of implementation in order to incorporate a wide range of interests of innovation actors from university and industry.

- Overemphasizing on the cooperative relations within the Triple Helix as a key condition for effective knowledge creation has led to the underestimation of impact of the existing regional innovation system and institutional relations on the practice of new patterns of innovation.

#### **8.4.2 Practical Contribution and Policy Implication**

This thesis has contributed to the existing knowledge-based innovation literature on managing innovation networks and implementing regional innovation policy. It has focused on the process of knowledge creation through interactive innovation networks between university, government and industry

Chapter 7 has drawn findings together to propose a theoretical model of effective knowledge-based innovation strategy at the regional level. The model should help to provide a richer insight and more balanced understanding from social and organizational perspective on designing and delivering innovation policies at regional level. As companies have been seeking gaining competitive advantages via knowledge creation, government have been seeking economic growth through creating innovative region, and universities have been increasingly acknowledged as the knowledge base for innovation, the findings from the thesis will provide innovation actors with a deeper knowledge of managing dynamic interactive process within innovation networks, changing perceptions, cultures and values and coordinating collective actions through effective learning.

There has been much discussions and debates across various disciplines on how to create knowledge-based innovation, but there has been lack of empirical and practical research has actually been taken on how innovation networks are formed, organized, performed and maintained and the challenges facing the innovation actors during the process of networking. The outcome of this research will provide a richer insight into how innovation capacity is enhanced through dynamic interactive process between academics, government support organizations and local industries in the North East region. The research will provide knowledge and understanding to managers, public and private business consultants, innovation researchers and policy makers with specific interests in managing effective implementation of knowledge-based innovation policy at regional level.

From policy perspective, there are a number of implications for policy makers in terms of designing new innovation policies for supporting regional knowledge economy. *First of all*, policy implementation does not follow a liner process based on the phases designed within the policy. Consideration needs to be taken into account to support the process of transitions and allow trust relationships developed over time. *Secondly*, it is important for policy makers to be aware of the diversified motivation and goals underlying the policy networks and develop appropriate support strategy to manage different perceptions and values between innovation actors. *Thirdly*, policy implementation requires partnerships across organizational boundaries, and effective partnership networks will depend on the shared leadership based on the appropriate formal authority as well as informal networks through social interactions. Thus strategies need to be developed to address the role of institutional leaders in creating meaningful and effective partnership networking. *Finally*, new initiatives will bring about changes that have impact on existing innovation system. This means traditional roles of actors will have to be refined and new ways of engagement and procedures will have to be understood and adapted. Appropriate strategic support for adapting changes needs to be considered for bridging the culture and value gap as well as building new structural for innovation.

Based on the analysis within the thesis, it is clear that if the transformation of the North East region into the knowledge economy is going to be successful, innovation policy needs to focus on developing more robust and endogenous capacities for

knowledge-based innovation through more concentrated action on resolving the conflicts agenda hidden behind the cooperative innovation strategy and managing the key issues that have been raised in this research in an appropriate and effective manner.

## **8.5 Recommendations for Further Research**

Innovation never ends. Firms and regions are continuously seeking new ways of improving and developing competence in order to succeed in the global market. It is increasingly recognized that the starting point for innovation is through knowledge creation and consequently various configurations and frameworks have been continuously designed and implemented.

The findings from current research have left, however two critical issues for innovation researchers and policy makers. (1) can knowledge gap be bridged with the facilitation of business support organizations through the structured intervention? Or knowledge will flow naturally only when a supportive environment is created in which all innovation actors are free to exchange information and share knowledge; (2) whether the new developments and frameworks designed and implemented for knowledge creation are reflecting the situation to which they refer. Drawing from empirical evidence, the remaining of this section will introduce a number of potential directions of further research which would help to tackle the two critical issues aforesaid.

As SfS programme has been designed as a ten-year strategic for developing knowledge economy, this research is conducted during the first development phase of the innovation strategy. The SfS programme has now moved onto the second phase of implementation which has involved restructuring and new configuration around the CoEs and adding new elements of innovation. Rather than dividing the regional research base into five technology areas, the new development initiative has proposed that the greatest opportunities for substantial economic growth arising in three main areas of activities as 'pillars' of the future economy of the North East Region. These pillars are: Healthcare and Health Sciences; Energy and Environment; and Process Innovation. Figure 8.1 shows the framework of the new development initiative within the SfS programme.

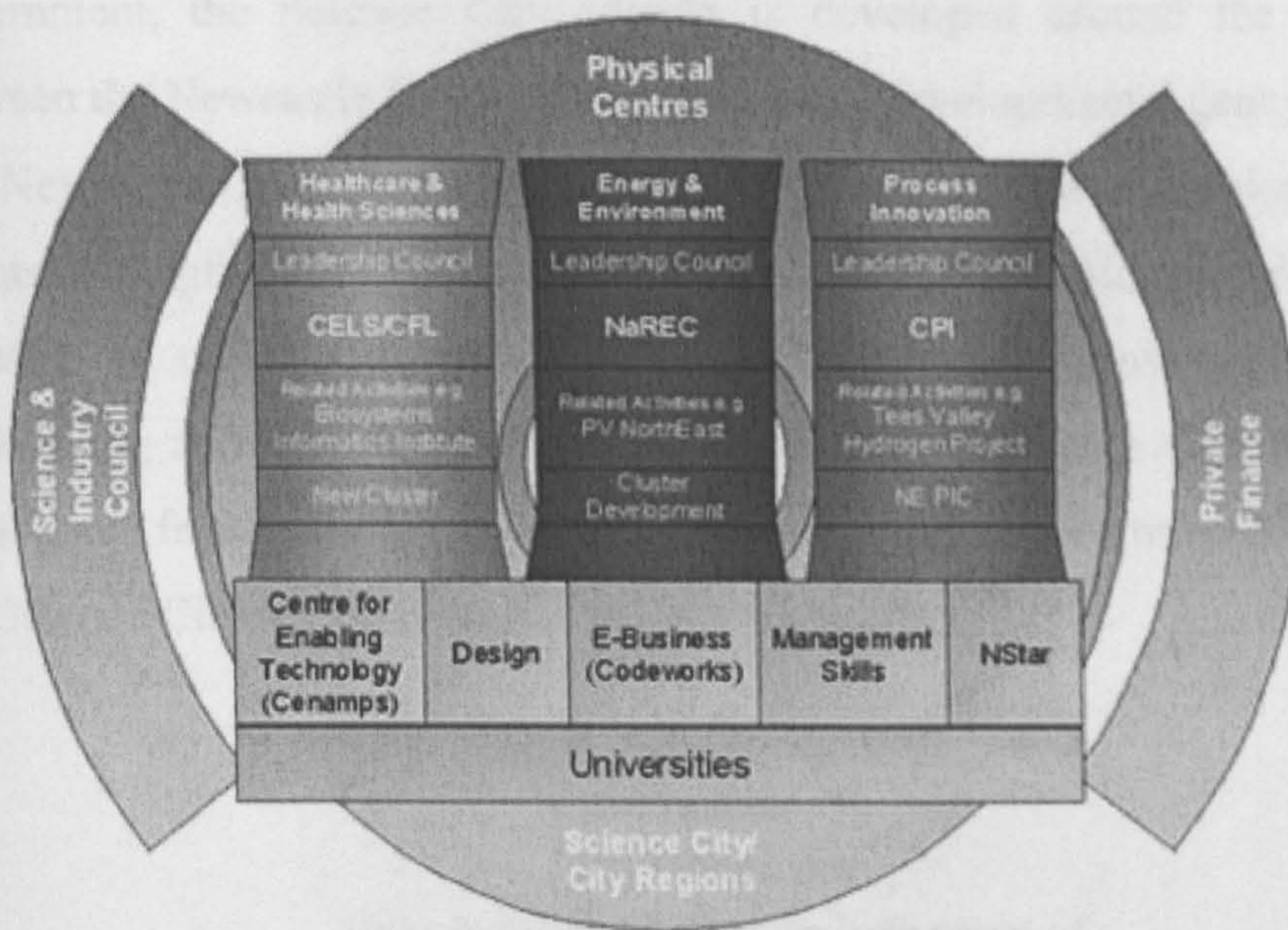


Figure 8.1 – the three pillars and the regional strategy for success

Figure 8.1 shows that the CoEs are closely aligned with the tree pillars (CELS, NaREC and CPI), and these would be further developed to focus on supporting technological innovation by business in these pillars. The pillars and centres would also be complemented by ‘underpinning’ activities in enabling technology, design, the E-agenda, management skills and venture finance (Nstar).

Whilst recognizing the new business opportunities that have brought about with new developments, it should be aware of that the innovation networks presented is merely a map of discernible reality and a way of conceptualizing the ways in which key actors should engage and interact in theory. The key question is to *what extent the vision of creating three pillars centred innovation can be translated into practice and how the cognitive map can also be developed to match the conceptual framework*. In particular, how the issues identified during the implementation of the first phase of knowledge-based innovation are managed and resolved, should be further explored and examined for the continuous improvement of SfS implementation in the long term.

Linking to the further development of SfS programme is the emerging Science City agenda which is seen as fundamental to support the overall culture change of science and innovation. Unlike other innovation programmes that have been initiated by

government, the Science City agenda is developed around the joint partnership between the Newcastle City Council, Regional Development Agency (One NorthEast) and Newcastle University. The purpose of Science City is to develop a new model for further strengthening the interactions between academic research scientists and industry by creating an innovation space where all industrially relevant science, engineering and medical disciplines will be able to engage with private companies, consultants from commercial world. The nature and role of university and business in the Science City are described in Figure 8.2 below:

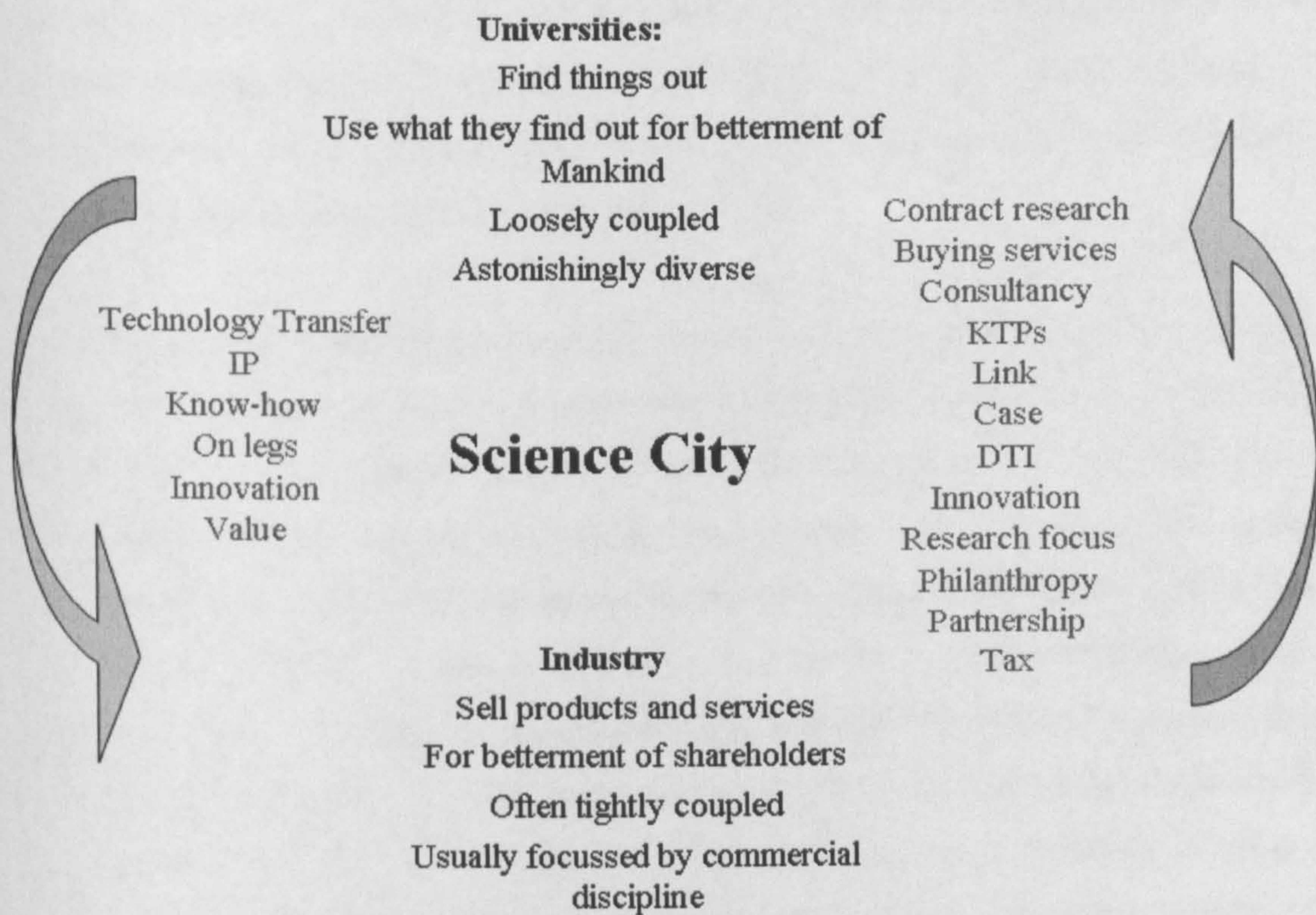


Figure 8.2 The Science City Initiative

The Science City initiative aims to mobilize existing resources within the university, such as enterprising centre, business school, career services etc. in the process of knowledge transfer by providing relevant tailor-made training on business management, well-educated students with enterprising skills and technical knowledge to facilitate the interactions between academics and private companies. The ultimate purpose of the SCI is trying to create a One Stop shop with all support and innovation system elements in place to conceive, incubate and supply a rich S2B (Scientists to



Business) and B2B (Business to Business) networks in the North East region.

The underlying assumption of the Science City Initiative is that space is seen as important and an alternative solution for innovation which has been approached from a structural perspective. The argument is that successful knowledge creation is likely to be achieved via 'creating space' rather than 'building bridge'. Thus, the SCI attempts to reduce or minimize the knowledge gap by creating a space of interaction rather than structural intervention. Whilst there are certainly a number of valuable concepts as well as the promising strategic visions underpinning the SCI in terms of enhancing university-industry interaction and knowledge transfer, the implementation of the £600m partnership-based initiative will have to face the same challenges of translating the policy networks based on partnership into practice through activating, organizing and facilitating the knowledge networks.

In addition, one of the issues identified from the practice of CoEs is the integration with other regional innovative practice and building up the innovation networks where knowledge can be shared naturally within the networks, how the SCI can be integrated with the existing knowledge infrastructure and other initiatives brought about by the new development phases within Sfs, need to be further explored and understood in practice, in particular it would be useful to compare the implementation process of SCI with CoEs in order to identify whether SCI would encounter similar issues that emerged from CoEs innovation networks. The on-going study on Sfs programme and the SCI would also help to build up a coherent process of implementing knowledge-based innovation at regional level, in which learning and improvement can be continuously developed in the long term.

## Reference

- ACS, Z. J. (1996) US clusters of innovation. IN (ED.), J. D. L. M. A. G. P. (Ed.) *Evolutionary Economics and the New International Political Economy*. London, Printer,.
- ACS, Z. J. (2000) *Regional Innovation, Knowledge and Global Change*, London and New York, Pinter.
- ADLER P. S. (2001) Market, Hierarchy, and Trust: The Knowledge Economy and the Future of Capitalism. *Organization Science*, 12, 215-234.
- AGRANOFF R.I. (1990) Frameworks for Comparative Analysis of Intergovernmental Relations. *SPEA Occasional Paper, Indiana University*, No. 26.
- AHRWEILER P. AND GILBERT N. AND PYKA A. (2005) Institutions matter but ...Organisational alignment in knowledge-based industries - the case of German and British bio-pharmaceuticals. *This work was partially supported by the German DAAD and the British Council within a three-year research project, Innovation networks in biotechnology-based industries*.
- AKG, A. E., BYRNE, J., KESKIN, H., LYNN, G. S. & IMAMOGLU, S. Z. (2005) Knowledge networks in new product development projects: A transactive memory perspective. *Information & Management*, 42, 1105-1120.
- ANDRIANI, P., JONES, C. H., W.S. AND BORGATTI, S.P., PEKMANN, M., PROPRI, L., SENA, V., DELBRIDGE, R., MOSLEIN, K. & NEEELY, A. (2005) Challenging Clusters: The Prospects and Pitfalls of Clustering for Innovation and Economic Development *Advanced Institute of Management Research*, June
- ANTONELLI, C. (1996) Localized knowledge percolation processes and information networks. *Journal of Evolutionary Economics*, 6, 281.
- AOKI, A. & ROSENBERG, N. (1987) *The Japanese Firm as an Innovating Institution*, Dept of Economics, Stanford University, California.
- APPLEGATE L.M. (1999) In Search of a New Organizational Model. IN DESANCTIS, J. F. A. G. (Ed.) *Shaping Organization Form: Communication, Connection and Community*. Sage Publications.
- ASHEIM, B. R. T. & COENEN, L. (2005) Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy*, 34, 1173-1190.
- ASHEIM, B. T. & COOKE, P. (1999) Local learning and interactive innovation networks in a global economy *Making connections: Technological learning and Regional Economic Change* Aldershot, Ashgate.
- ASHEIM, B. T. & GERTLER, M. S. (2005) The Geography of Innovation: Regional Innovation System IN FAGERBERG, J., MOWERY, D. & NELSON, R. (Eds.) *The Oxford Handbook of Innovation* Oxford University Press
- ASHEIM, B. T. & ISAKSEN, A. (1997) Location, Agglomeration and Innovation: Towards Regional Innovation Systems in Norway? . *European Planning Studies*, 5, 299-330.
- BABER, Z. (2001) Globalization and Scientific Research: The Emerging Triple Helix of State-Industry-University Relations in Japan and Singapore *Bulletin of Science Technology Society*, 21, 401-408.
- BALL S. (1993) Beachside Reconsidered: reflections on a Methodological Apprenticeship. IN BURGESS B., E. (Ed.) *The Research Process in Educational Settings: Ten Case Studies*. London, The Falmer Press.
- BARNES D. (2001) Research methods for the empirical investigation of the process of formation of operations strategy. *International Journal of Operations & Production*

*Management*, Vol 21, 1076-1095.

BAUM, J. A. C., CALABRESE, T. & SILVERMAN, B. S. (2000) Don't get it alone: Alliance network composition and startup's performance in canadian Biotechnology *Strategic Management Journal* 21, 267-94.

BAUMARD, P. (1999) *Tacit knowledge in organizations*, London, Sage Publications.

BECCATINI, G. (1990) The Marshallian Industrial District as socio-economic notion. IN PYKE F. BECCATINI G. AND SENGENDERGER W. (ED.). (Ed.) *Industrial Districts and Inter-firm Cooperation in Italy* Geneva International Institute for Labour Statistics

BEER M. AND EISENSTAT R.A. AND SPECTOR B. (1990) Why Change Programms Don't Produce Change. *Harvard Business Review*, Nov - Dec.

BEESEY, L. G. A. (2003) Science policy in changing times: are governments poised to take full advantage of an institution in transition? *Research Policy*, 32, 1519.

BENNEWORTH, P. (2001) Academic Entrepreneurship and Long-Term Business Relationships: Understanding 'Commercialization' Activities. *Enterprise & Innovation Management Studies*, 2, 225-237.

BENZ, A. & FURST, D. (2002) Policy Learning in Regional Networks *European Urban and Regional Studies*, 9, 21-35.

BERNARD, H. R. (1988) *Research Methods in Cultural Anthropology* Newbury Park CA: Sage

BESSANT, J., CAFFYN, S. & CGILBERT, J. (1996) Learning to Manage Innovation *Technology Analysis and Strategic Management*, Vol 8, 59-70.

BEST M. (1990) *The New Competition: institutions of industrial restructuring*, Cambridge Mass, Polity Press.

BIEMANS W. (1992) *Managing Innovation within Networks*, London, Routledge.

BIJKER, W. E., HUGHES, T. P. & PINCH, T. (1987) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* MIT Press, Cambridge, MA.

BLAXTER L. HUGES C. AND TIGHT MALCOLM (2002) *How to research*, Buckingham Philadelphia, Open University Press.

BOEKEMA F. AND MORGAN K. AND BAKKERS S. AND RUTTEN R. (2000) Introduction to Learning Region: a New Issue for analysis? IN BOEKEMA F. AND MORGAN K. AND BAKKERS S. AND RUTTEN R. (ED.) (Ed.) *Knowledge, Innovation and Economic Growth*. Edward Elgar.

BOISOT M. (1994) *Information and Organizations*, Harper Collins Publishers.

BOSCHMA, R. A. (1999) The rise of clusters of innovative industries in Belgium during the industrial epoch. *Research Policy*, 28, 853-871.

BOUTELLIER R., G. O., MACHO H. AND ROUX M., (1998) Management of dispersed product development teams: the role of information technologies. *R & D Management*, 28, 13-26.

BRESNEN M. (1988) Insights on site: research into construction project. IN (ED.), B. A. (Ed.) *Doing Research in Orgnaizations*. Routledge.

BROWN, J. S. & DUGUID, P. (2002) Local Knowledge: Innovation in the Networked Age. *Management Learning*, 33, 427-437.

BRYMAN A. (1988) *Doing Research in Orgnaizations*, Routledge.

BRYMAN A. (1989) *Research Methods and Organization Studies*, London, Unwin Hyman Ltd.

BRYSON J R AND DANIELS P W AND HENRY N D AND POLLARD J. (2000) The State and The Contradictions of the knowledge Driven -Economy. *Knowledge, Space, Economy*. London, Routledge.

- BUCHANAN D. AND BODDY D. (1992) *The Expertise of the Change Agent: Public Performance and Backstage Activity*, Prentick Hall.
- BURGESS R.G. (1982) *Field Research: A sourcebook and Field Manual*, London, Allen and Unwin.
- BURT R.S. (1992) Structural holes: The social structure of competition. *Harvard Business Review*, Cambridge, MA.
- CAMAGNI R. (1991) *Innovation Networks : Spatial Perspectives*, London Printer.
- CANTWELL, J. (1999) Clusters and Networks. IN DTI (Ed.) *The Economics of The Knowledge Drive Economy*. London, The Centre of Economic Policy Research.
- CASTELLS M. (1996) *The Rise of the Network Society: The Information Age: Economy, Society and Culture*, Oxford, Blackwell.
- CASTELLS M. (2000) *Information Age: Economy, Society and Culture*, Oxford, Blackwell.
- CASTILLA E. AND HWANG H. AND GRANOVERTER E. AND GRANOVERTER M. (2000) Social networks in Silican Valley. IN LEE C. ET.AL (EDS). (Ed.) *The Silicon Valley Edge*. Stanford, CA: Standford University Press.
- CHAITON A; DIBBITS T; PAQUET G; ROY J; WILSON C; (2002) The collaborative challenges of Regional Governance: Civic Entrepreneurs and New Social Technologies. IN NAMAMURA, M. (Ed.) *Alliance, Cooperative Ventures and The Role of Government in the Knowledge Based Economy*. The Centre of Japanese Research, The University of British Columbia.
- CHARLES, D. & BENNEWORTH, P. (2001) Clustering and Economic Complexity: Regional ICT Clusters in the United Kingdom. IN BERGMAN, E., CHARLES, D. & HERTOOG (ED), P. D. (Eds.) *Innovative Clusters: Drivers of National Innovation Systems*. OECD Proceedings.
- CHISHOLM D. (1989) *Coordination without hierarchy*, Berkeley, University of California Press.
- COBBENHAGEN, J. & SEVERIJNS, J. (1999) Towards a Knowledge-Insensive Regional Economy. IN KEVIN MORGAN AND CLAIRE NAUWELAERS (EDS) (Ed.) *Regional Innovation Strategies:The Challenge for Less-Favoured Regions*. Routledge Taylor & Francis Group.
- COCKBURN I. AND HENDERSON R. (1998) Absorptive Capacity, coauthoring behaviour, and the organizationa of research in drug discovery. *Journal of Industrial Economics*, XLVI, 157-182.
- COFFEY, A. & ATKINSON, P. (1996) *Making Sense of Qualitative Data*, London, Sage
- COHEN, S. S. & FIELDS, G. (1999) Social capital and capital gains in Silican Valley: . *California Management Review* 41, 108-130.
- COHEN W.M. AND LEVINTHAL D.A. (1990) Absorptive Capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 35, 128-152.
- COLLINSON, S. (2000) Knowledge networks for innovation in small Scottish software firms. *Entrepreneurship & Regional Development*, 12, 217-244.
- COMOR E. (2002) When More is Less: Time, Space and Knowledge in Information Societies. IN EDITED BY MELODY W.H. AND MANSELL R. AND SAMARAJIVA R. AND MAHAN A. (Ed.) *Newtorking Knowledge for Information Societies: Institutions and Intervention*. Delft: DUP Science.
- COOKE, P. (1992) Regional Innovation System: Competitive Regulation in the New Europe *Geoforum*, 23, 365-82.
- COOKE, P. (1998a) Introduction: Origins of the Concept. IN H. BRACZYK, P. C. A.

- M. H. E. (Ed.) *Regional Innovation Systems*. London UCL Press
- COOKE, P. (1998b) Regional Innovation System: Design for the Future Centre for Advanced Studies, Cardiff University
- COOKE, P. (2001) Regional Innovation Systems, Clusters, and the Knowledge Economy. *Industrial & Corporate Change*, 10, 945-974.
- COOKE, P. (2004) The role of research in regional innovation systems: new models meeting knowledge economy demands. *International Journal of Technology Management*, 28, 507-533.
- COOKE, P. (2005) Regionally asymmetric knowledge capabilities and open innovation: Exploring 'Globalisation' - A new model of industry organisation. *Research Policy*, 34, 1128-1149.
- COOKE P AND MORGAN K. (1998) *The Associational Economy, Firms, Regions and Innovation*, Oxford, University Press, Oxford, UK.
- COOKE, P. & MORGAN, K. (1998) *The Associational Economy*, London, Oxford University Press.
- COOKE P. (1998) Regional Innovation System - an evolutionary approach. IN COOKE P. AND HEIDENREICH M. AND BRACZYK HANS-JOACHIM (ED.) (Ed.) *Regional Innovation Systems: the role of governance in a globalized world*. London, Routledge.
- COOPERS & LYBRAND (USA). (1995) *Report on University-Business Joint Ventures*, Washington Coopers & Lybrand.
- CROOMBS R., A. R. A., AND SAVIOTTI P. AND WALSH V., (1996) Introduction: Technological Collaboration and networks of alliances in the innovation process. IN COOMBS R., R. A., SAVIOTTI P., AND WALSH V. (Ed.) *Technological Collaboration: The Dynamics of Cooperation in Industrial Innovation*, Cheltenham, Edward Elgar.
- CROZIER M. AND FRIEDBERG E. (1980) *Actors and Systems: The Politics of Collective Action*, University of Chicago Press.
- CURDS (CENTRE FOR URBAN & REGIONAL DEVELOPMENT STUDIES); (2004) *Regional Science Policy & Instruments: an overview of British Developments*.
- D'AVENI R.A. (1994) *Hypercompetition: Managing the Dynamic of Strategic Manoeuvring*, New York, Free Press.
- DA SILVA, F. Q. B. (2001) What Should Be the Role of Government in Innovation Projects? Some Proposals from the Spin Project in Brazil. *Journal of Enterprising Culture*, 9, 91.
- DALUM, B. (1995) Local and Global Linkages: the radio communications cluster in northern Denmark. *Department of Business Studies*, University Aalborg (mimeo).
- DEPARTMENT OF TRADE AND INDUSTRY/DEPARTMENT OF EDUCATION AND EMPLOYMENT (2001) *Opportunity for all in a world of change: a white paper on Enterprise, Skills and Innovation* IN DTI (Ed.), The Stationery Office, London
- DOSI G. (1988) The Nature of the Innovation Process. IN (ED.), S. L. (Ed.) *Technical Change and Economic Theory*. London, Printer Publishers.
- DRAPER, S. W. (1988) what's going on in everyday explanation IN C. ANTAKI (ED.) (Ed.) *Analyzing everyday explanation: A casebook of methods*. Newbury Park, CA: Sage.
- DRAZIN, R. & SCHOONHOVEN, C. B. (1996) Community, population and organization effects on innovation: a multilevel perspective. *Academy of Management Journal*, 39, 1065-1083.
- DTI. (2002) *Competing in Global Economy - The Innovation Challenge*. London, DTI Economics Paper No 7.

- DUNN W.N. (1981) *Public Policy Analysis: An Introduction*, Prentice-Hall, Englewood Cliffs, NJ.
- DUNNING J. (2000) *Regions, Globalization, and the Knowledge-Based Economy*, New York, Oxford University Press Inc.
- ECDE (2004) *Innovation Management and the Knowledge Driven Economy*. European Commission Directorate-general for Enterprise, CSC-EC-EAEC Brussels-Luxembourg,.
- EDQUIST, C. & JOHNSON, B. (1997) *Institutions and Organization in Systems of Innovation* IN (ED.), C. E. (Ed.) *Systems of Innovation -Technologies, Institutions and Organizations*. London/washington, Printer
- EDWARDS, T., BATTISTI, G. & NEELY, A. (2004) Value creation and the UK economy: a review of strategic options. *International Journal of Management Reviews*, Vol. 5/6 Issue 3, 191-213.
- EISENHARDT, K. M. (1989) Building theories from case study research. *Academy of Management Review*, 14, 532-550.
- ENRIGHT, M. (1995) *Regional Clusters and Economic Development: A research agenda*. MA: Harvard Business School Working Paper Cambridge
- ETZKOWITZ, H. (2002) Networks of Innovation: Science, Technology and Development in the Triple Helix Era. *International Journal of Technology Management & Sustainable Development*, 1, 7.
- ETZKOWITZ, H. (2003) Innovation in Innovation: The Triple Helix of University-Industry-Government Relations  
10.1177/05390184030423002. *Social Science Information*, 42, 293-337.
- ETZKOWITZ, H. (2004) The evolution of the entrepreneurial university. *International Journal of Technology & Globalization*, 1, 64-77.
- ETZKOWITZ, H. & DE MELLO, J. M. C. (2003) The rise of a triple helix culture. *International Journal of Technology Management & Sustainable Development*, 2, 159-171.
- ETZKOWITZ, H. & KLOFSTEN, M. (2005) The innovating region: toward a theory of knowledge-based regional development. *R & D Management*, 35, 243-255.
- ETZKOWITZ, H. & WOLFF, M. F. (2000) Tech Transfer, Incubators Probed at Triple Helix III. *Research Technology Management*, 43, 4.
- ETZKOWITZ H. AND LEYDESDORFF L. (1997) Introduction to special issues on science policy dimensions of the Triple Helix of University-industry-government relations. *Science & Public Policy*, Vol 24.
- ETZKOWITZ H. AND LEYDESDORFF L. (2001) *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations*, London and New York, Continuum.
- EUROPEAN COMMISSIONS (2002) *Innovation Tomorrow: Innovation policy and the regulatory framework: Making innovation an integral part of the broader structural agenda*. *Innovation Papers No 28*.
- EUROPEAN COMMISSION (1995) *Green Paper on Innovation COM. 688*.
- FAGERBERG, J., MOWERY, D. & NELSON, R. (2005) *The Oxford Handbook of Innovation* Oxford University Press
- FLORIDA R. (1995) Towards the Learning Region 27(5):. *Futures*, Vol 27, 527-536.
- FLORIDA R. (2000) The Learning Region. IN ACS J. Z. (ED.) (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Pinter.
- FORNAHL D. AND BRENNER T. (2003) *Cooperation, Networks, and Institutions in Regional Innovations Systems*, Cheltenham: Edward Elgar.

- FOUNTAIN J. (2001) *The Virtual State*.
- FREEMAN, C. (1993) ??? ???
- FREEMAN C. (1987) *Technology Policy and Economic Performance: Lessons from Japan*, London, Pinter.
- FRENKEL, A. (2003) Barriers and Limitations in the Development of Industrial Innovation in the Region. *European Planning Studies*, 11, 115.
- FRIEND J.K. AND POWER J.M. AND YEWLETT C.J.L. (1974) *Public Planning: The Inter-Corporate Dimension*, London, Tavistock.
- FROMHOLD-EISEBITH, M. & EISEBITH, G. (2005) How to institutionalize innovative clusters? Comparing explicit top-down and implicit bottom-up approaches. *Research Policy*, 34, 1250-1268.
- FUJIGAKI, Y. & LEYDESDORFF, L. (2000) Quality control and validation boundaries in a triple helix of university-industry-government: "Mode 2" and the future of university research  
*Social Science Information*, 39, 635-655.
- FULLER M. (1993) Dimensions of Gender in a School: Reinventing the Wheel? IN BURGESS B., E. (Ed.) *The Research Process in Educational Settings: Ten Case studies*. London, The Falmer Press.
- FURMAN, J. L., PORTER, M. E. & STERN, S. (2000) Understanding the Drivers of National Innovative Capacity. *Academy of Management Proceedings*, 1.
- FURMAN, J. L., PORTER, M. E. & STERN, S. (2002) The determinants of national innovative capacity. *Research Policy*, 31, 899.
- GEBHARDT, C., POHLMANN, M. & ETZKOWITZ, H. (2004) Preface: The global paradigm of networking as an underlying rationality of programming innovation policies. *International Journal of Technology Management*, 27, 431-439.
- GEMMELL, N. (1997) Externalities to Higher Education: A review of the new growth literature. *Report no 8 of the National Committee of Inquiry into Higher Education*. London, Crown Copyright.
- GEMUNDEN, H. G., RITTER, T. & HEYDEBRECK, P. (1996) Network Configuration and innovation success: an empirical analysis in German high-tech industries. *International Journal of Research in Marketing*, 13, 449-462.
- GIBBONS, M., LIMOGES, C., NOWOTNY, H., SCHWARTZMAN, S., SCOTT, P. & TROW, M. (1994) *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, Sage Publications.
- GIESECKE, S. (2000) The contrasting roles of government in the development of biotechnology industry in the US and. *Research Policy*, 29, 205.
- GILLHAM B. (2000) *Case Study Research Methods*, London, Continuum.
- GLASER B. AND STRAUSS A. (1967) *The discovery of Grounded Theory: Strategies of Qualitative Research*, London, Weidenfeld & Nicolson.
- GODDARD J. (1994) *Universities and Communities*, London, CVCP.
- GODDARD J. (1997) Report for the UK Department for Education and Employment on University and Economic Development.
- GODDARD J. (1999) How Universities can Thrive Locally in a Global Economy. IN GRAY HARRY (ED.) (Ed.) *Universities and the Creation of Wealth*. The Society for Research into Higher Education & Open University Press.
- GODDARD J. (1997) Universities and Regional Development: An Overview. IN BACKGROUND PAPER TO OECD PROJECT ON THE RESPONSE OF HIGHER EDUCATION TO REGIONAL NEEDS (Ed.), Centre for Urban and Regional Development Studies, University of Newcastle upon Tyne.
- GORDON, R. & KIMBALL, L. (1998) Globalization, Innovation, and Regional

- Development. *Competition & Change*, 9.
- GOSSLING T. (2004) Proximity, Trust and Morality in Networks. *European Planning Studies*, Vol 12.
- GRABHER (1993) *The Embedded firm: On the socio-economics of industrial networks* London Routledge
- GRANT HARMAN, KAY HARMAN & NBSP (2004) Governments and universities as the main drivers of enhanced Australian University research commercialisation capability. *Journal of Higher Education Policy & Management*, 26, 153-169.
- GULBRANDSEN, M. & SMEBY, J.-C. (2002) The External orientation of University researchers: implications for academic performance and management *The 4th Triple Helix Conference*. Copenhagen, November
- GUNASEKARA, C. (2004) The Third Role of Australian Universities in Human Capital Formation. *Journal of Higher Education Policy & Management*, 26, 329-343.
- GUNASEKARA, C. (2005) The role of universities in shaping regional agglomeration: case studies in the Australian setting. *International Journal of Technology Transfer & Commercialisation*, 4, 7-7.
- HARMAAKORPI V. AND MELKAS H. (2005) Knowledge Management in Regional Innovation Networks: The Case of Lahti, Finland. *European Planning Studies*, Vol 13.
- HARRIS L. AND COLES A.M. K. AND MCLOUGHLIN I.P. (1999) Building collaborative networks. IN JACKSON P.J. (Ed.) *Virtual working: social and organizational dynamics*. London and New York, Routledge.
- HARRIS, R. G. (2001) The knowledge-based economy: intellectual origins and new economic perspectives. *International Journal of Management Reviews*, Vol. 3.
- HARTLEY J.F. (1994) Case Studies in Organization Research. IN CASSELL C. AND SYMON G. (Ed.) *Qualitative Methods in Organizational Research*. Sage Publications.
- HASSINK, R. (2003) *Regional Innovation Policy: case studies from Urban area*, Utrecht: NGS, Baden-Wurttemberg and the North East of England.
- HEIDENREICH M. (1998) Conclusion. IN COOKE P. AND HEIDENREICH M. AND BRACZYK HANS-JOACHIM (ED.) (Ed.) *Regional Innovation Systems: the role of governance in a globalized world*. London, Routledge.
- HODGSON, G. (1988) *Economics and Institutions - A Manifesto for a Modern Institutional Economics* Cambridge: , Policy Press
- HOWELL. (1996) Tacit Knowledge, Innovation and Technology Transfer. *Technology Analysis and Strategic Management*, Vol 8, pp 91-106.
- HUGGINS, R. (1998) Local Business Co-operation and Training and Enterprise Councils: The Development of Inter-firm Networks. *Regional Studies*, 32, 813-826.
- HUGGINS R. (1997) Competitiveness and the Global Region: The Role of Networking. IN SIMMIE JAMES(ED.). (Ed.) *Innovation, Networks and Learning Regions?* London, Jessica Kinsley Publishers Ltd.
- INZELT, A. R. (2004) The evolution of university-“industry”-government relationships during transition. *Research Policy*, 975-995.
- JAFFE A.B. AND TRAJTENBERG M. AND HENDERSON R. (1993) Geographic localization of knowledge spillovers as evidenced by patent citations. *Quarterly Journal of Economics*, 63, 577-598.
- JENSEN, C. & TRGRDH, B. (2004) Narrating the Triple Helix concept in 'weak' regions: lessons from Sweden. *International Journal of Technology Management*, 27, 513-530.
- KANTER R.M. (1989) *When Giants Learn to Dance*, London, Simon and Schuster.
- KAPLAN, A. (1964) *The Conduct of Inquiry* Sranon, PA: Chandler.
- KING N. (1994) The Qualitative Research Interview. IN CASSELL C. AND SYMON



- G. (Ed.) *Qualitative Methods in Organizational Research*. Sage Publications.
- KLIEN, H. K. & MAXWELL, J. (1994) A set of principles for conducting and evaluating interpretive field studies *MIS Quarterly*, Mar vol 23, 67-94.
- KLIJN, E.-H., KOPPENJAN, J. & TERMEER, K. (1995) Managing Networks in the Public Sector: a Theoretical Study of Management Strategies in Policy Networks. *Public Administration*, 73, 437-454.
- KLINE, S. J. & ROSENBERG, N. (1986) An Overview of Innovation. IN LANDAU, R. A. R. N. E. (Ed.) *The positive Sum Strategy. Harnessing Technology for Economic Growth*. Washington, D.C., National Academy Press.
- KNIGHT, R. V. (1995) Knowledge-based Development: Policy and Planning Implications for Cities. *Urban Studies*, 32, 225-260.
- KOGUT, B., SHAN, W. & WALKER, G. (1993) Knowledge in network and the network as knowledge: the structuring of new industries. IN (ED.), G. G. (Ed.) *The Embedded Firm: On the Socio-Economics of Industrial Networks* London Routledge.
- KROGH GEORG VON AND ROOS JOHAN (1996) *Managing knowledge : perspectives on cooperation and competition*, London, Sage.
- KRUGMAN, P. (1995) *Development, Geography and Economic Theory*, London, MIT Press.
- KVALE S. (1983) The Qualitative Reserach Interview: A phenomenological and a hermeneutical mode of understanding. *Journal of Phenomenological Psychology*, 14, 171-96.
- LAMBERT R. (2003) Lambert Review of Business-University Collaboration. London, [www.lambertreview.org.uk](http://www.lambertreview.org.uk).
- LAMBOOY J. (2004) The Transmission of Knowledge, Emerging Networks, and The Role of Universities: An Evolutionary Approach. *European Planning Studies*, Vol. 12.
- LAMBOOY, J. G. (2004) The transmission of knowledge, emerging networks, and the role of universities: an evolutionary approach. *European Planning Studies*, 12, 643-657.
- LANE CHRISTEL AND BACHMANN REINHARD (1998) *Trust within and between organizations : conceptual issues and empirical applications*, New York, Oxford University Press.
- LANGBERG, K. (2002) Managing in the Triple Helix - from the University perspective *Triple Helix -conference Copenhagen, November*
- LARSON, A. (1992) Network Dyads in Entrepreneurial Settings :A study of hte Governance Exchange Processes *Administrative Science Quarterly* 37, 76-104.
- LAWTON SMITH, H. (2003) Knowledge organizations and the Local Economic Development : The case of Oxford and Grenoble *Regional Studies* 37.
- LAZZERONI, M. & PICCALUGA, A. (2003) Towards the Entrepreneurial University. *Local Economy*, 18, 38.
- LEYDESDORFF, L. (2000) The triple helix: an evolutionary model of innovations. *Research Policy*, 29, 243.
- LEYDESDORFF, L. (2001) Knowledge-based Innovation system and the Model of a Triple Helix of University-Industry-Government Relations *Paper presented in New Economic Windows: New Paradigms for the New Millennium*. Salerno, Italy , 14th September
- LEYDESDORFF, L. & ETZKOWITZ, H. (1998) The Triple Helix as a Model for Innovation Studies *Science & Public Policy* Vol 25, 195-203.
- LEYDESDORFF L. (2001) Knowledge-Based Innovation Systems and the Model of a Triple Helix of University - Industry - Government Relations. *Proceedings New Economic Windows, New Paradigms for the New Millennium*, Salerno.

- LIEBESKIND J.P. AND OLIVER A.L. AND ZUCKER L. AND BREWER M. (1996) Social networks, Learning and flexibility: sourcing scientific knowledge in new biotechnology firms. *Organization Science*, 7, 428-443.
- LIM, K. (2000) The many faces of absorptive capacity: spillovers of copper interconnect technology for semiconductor chips. *Mimeo, MIT*.
- LINDLEY R.M. (2002) Knowledge based economies: the European employment debate in a new context. IN RODRIGUES M. J. (ED) (Ed.) *The New Knowledge Economy in Europe*. Edward Elgar.
- LIPIETZ, A. (1992) *Towards a new Economic Order* Cambridge Polity
- LOPEZ-MARTINEZ R.E. AND PICCALUGA A. (2000a) Introduction: the meso-foundation of national innovation system. IN LOPEZ-MARTINEZ R.E. AND PICCALUGA A. (ED.) (Ed.) *Knowledge Flows in National Innovation System*. Edward Elgar Publishing Ltd.
- LOPEZ-MARTINEZ R.E. AND PICCALUGA A. (2000b) *Knowledge flows in National Systems of Innovation*, Edward Elgar Publishing Ltd.
- LORENZ, C. (1995) In Two Minds. *Financial Times* Vol 10.
- LUNDAVALL, B. A. (1988) Innovation as an interactive process: from user-producer interaction to the national system of innovation IN (ED), G. D. (Ed.) *Technical Change and Economic Theory* London Pinter
- LUNDAVALL B-A. AND BORRAS S. (1997) *The Globalising Learning Economy: Implications for Innovation Policy*. Luxembourg:, Office for Official publications for the European Communities.
- LUNDAVALL B. -A. (1992) *National System of Innovation: towards a theory of innovation and interactive learning*, London, Pinter Publishers.
- MACARTHUR, M. (2000) The Triple Helix (Book review). *Library Journal*, 125, 126.
- MALECKI E.J. (2000) Network Models for Technology-Based Growth. IN ACS J. Z. (ED.) (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Pinter.
- MARQUES, J. P. C., CARAÃÇA, J. M. G. & DIZ, H. (2006) How can university“industry“government interactions change the innovation scenario in Portugal?“the case of the University of Coimbra. *Technovation*, 26, 534-542.
- MARSHALL J. (1981) Making Sense as a personal process. IN REASON P. AND ROWAN J. (EDS) (Ed.) *Human Inquiry: A Sourcebook of New Paradigm Research*. Chichester, Wiley.
- MARSHALL J. AND RICHARDSON R. AND HOPKIN J. (1999) The Employment Implications of Civil Service Reform in the United Kingdom: National and Regional Evidence from the North East of England. *Environment and Planning*, 31, 803-807.
- MASKELL, P. (2001) Towards of Knowledge-based Theory of the Geographical Cluster. *Industrial & Corporate Change*, 10, 921-943.
- MASON, J. (1996) *Qualitative Researching* London Sage
- MEREDITH, J. R., RATURI, A., AMOAKO-GYMPAH, K. & KAPLAN, B. (1989) Alternative Research Paradigms in operation. *Journal of Operations Management*, Vol. 8, pp 297-326.
- METCALFE, J. S. (1998) *Evolutionary Economics and Creative Destruction* London Routledge
- MILES, M. & HUBERMAN, A. (1984) *Qualitative Data Analysis* London Sage
- MILES M.B. AND HUBERMAN A.M. (1994) *Qualitative Data Analysis*, London, Sage.
- MILES R.E. AND SNOW C.C. (1992) Causes of failure in network organizations.

- California Management Review*, 34, 53-62.
- MISZTAL B.A. (1996) *Trust in Modern Societies*, Oxford: Polity Press.
- MOLINA-MORALES, F. X., LOPEZ-NAVARRO, M. A. & GUIA-JULVE, J. (2002) The Role of Local Institutions as Intermediary Agents in the Industrial District. *European Urban and Regional Studies*, 9, 315-329.
- MOORE, C. W. (1986) *The Mediation Process: practical strategies for resolving conflict*, San Francisco CA, Jossey Bass.
- MORGAN G. (1997) *Images of Organization*, Sage Publication.
- MORGAN, K. & NAUWELAERS, C. (1999) A Regional Perspective on Innovation: From Theory to Strategy. IN KEVIN MORGAN AND CLAIRE NAUWELAERS (EDS) (Ed.) *Regional Innovation Strategies: The Challenge for Less-Favoured Regions*. Routledge Taylor & Francis Group.
- MORGAN K. (1997) The learning region: institutions, innovation and regional renewal. *Regional Studies*, Vol 31, 491-503.
- MOTHE DELA, J. & PAQUET, G. (2000) National Innovation Systems and Instituted Processes. IN ACS, Z. J. E. (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Pinter.
- MULKAY, M. J. (1972) *The Social Process of Innovation* London Macmillan Press Ltd
- MYERS, S. & MARQUIS, D. G. (1969) *Successful Industrial Innovation*, Washington, D.C., National Science Foundation.
- MYTELKA, L. K. & SMITH, K. (2002) Policy Learning and Innovation Theory: an Interactive and Co-evolving Process. *Research Policy* 31, 1467-1479.
- NANDHAKUMAR J. (1999) virtual teams and lost proximity: consequences on trust and relationships. IN JACKSON P.J. (Ed.) *Virtual working: social and organizational dynamics*. London and New York, Routledge.
- NAUWELAERS, C. (1999) Creating a Regional Innovation Policy in Lorraine. IN KEVIN MORGAN AND CLAIRE NAUWELAERS (EDS) (Ed.) *Regional Innovation Strategies: The Challenge for Less-Favoured Regions*. Routledge Taylor & Francis Group.
- NAUWELAERS, C. (2000) Policy learning for innovation in European Regions *paper presented for RESTPOR 2000*. Kashikojima.
- NELSON, R. R. (2000) National Innovation System. IN ACS, J. Z. E. (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Printer.
- NERKAR, A. & PARUCHURI, S. (2005) Evolution of R&D Capabilities: The Role of Knowledge Networks Within a Firm. *Management Science*, 51, 771-785.
- NEWELL, S., ROBERTSON, M., SCARBROUGH, H. & SWAN, J. (2002) *Managing Knowledge Work*, Basingstoke: Palgrave.
- NEWLANDS D. (2002) The Contribution of Universities to Regional Economic Development. IN HIGANO Y. AND NIJKAMP P. AND POOT J. AND WYK K.V. (ED) (Ed.) *The Region in the New Economy: An international perspective on regional dynamics in the 21st century*. Ashgate.
- NONAKA, I. & TAKEUCHI, H. (1995) *The Knowledge-creating company*, New York, Oxford University Press.
- NOOTEBOOM, B. (1999) Innovation and inter-firm linkages: new implications for policy. *Research Policy*, 28, 793-805.
- NOOTEBOOM, B. (2000) *Learning and Innovation in Organizations and Economics*, Oxford, Oxford University Press.
- O'BRIEN, N. D. (2000) Government in the Knowledge Age - how government can lead with knowledge *Knowledge Management Review* 3, pp 30-33.

- O'CONNOR D; SHIELDS R; ILCAN S; TABORSKY E; (2002) Information and Knowledge Economies: Work and Management in the Canadian Federal Public Service. IN KECHENG LIU; RODNEY J. CLARKE; PETER BOGH ANDERSON; RONALD STAMPER; EL-SAYED ABOU ZEID; (Ed.) *Organizational Semiotics: Evolving Science of Information Systems*. Kluwer Academic Publishers.
- OECD (1996) The Knowledge-Based Economy. Paris. STI Outlook.
- OECD (1999) Boosting Innovation: The cluster approach. *OECD Proceedings*. Paris: The Organization for Economic Cooperation and Development.
- OECD; (2000) Innovation and Economic Performance. *DSTI/STP*, OECD, Paris.
- OWEN-SMITH, J. & POWELL, W. W. (2004) Knowledge Networks as Channels and Conduits: The Effects of Spillovers in the Boston Biotechnology Community. *Organization Science: A Journal of the Institute of Management Sciences*, 15, 5-21.
- PATEL, P. & PAVITT, K. (1991) Large firms in the production of the world's technology: An Important case of non-Globalization. *Journal of International business Studies* Vol 22, 1-12.
- PATEL, P. & PAVITT, K. (1994) National Innovation Systems: Why they are important and how they might be measured and compared. *Economics of Innovation and New Technology*, 3, 77-95.
- PAULEEN D.J. AND YOONG P. (2001) Relationship buliding and the use of ICT in boundary-crossing virtual teams: a facilitator's perspective. *Journal of Information Technology*, 16, 205-220.
- PETTERS B.G. (1998) Managing Horizontal Goverment: The Politics of Coordination. *Public Administratiion*, Vol 76, 295-311.
- PETTIGREW A.M. (1990) Longitudinal field research on change: theory and ractice. *Organization Science*, 1, 267-292.
- PETTIGREW A.M. AND WHIPP R. (1991) *Managing Change for Competitive Success*, Oxford, Blackwell.
- PIAGET, J. (1971) *Structuralism* London Routledge
- PITTAWAY, L., ROBERTSON, M., MUNIR, K., DENYER, D. & NEELY, A. (2004) Networking and innovation: a systematic review of the evidence. *International Journal of Management Reviews*, Vol. 5/6, p137-168, 32p.
- POLANYI M. (1967) *The Tacit Dimension*, London, Routledge and Kegan Paul.
- PORTER M. E. (1990) *The Competitive Advantage of Nations*, Basingstoke, McMillan.
- PORTER, M. E. (1985) *Competitive Advantages*, New York, Free Press.
- PORTER, M. E. (2000) Location, competition, and economic development: local clusters in a global economy. *Economic Development Quarterly*, 14, 15-34.
- POWELL, W. W. & GRODAL, S. (2005) Networks of Innovators IN FAGERBERG, J., MOWERY, D. & NELSON, R. (Eds.) *The Oxford Handook of Innovation* Oxford University Press
- PRAHALD C.K. AND HAMEL G. (1990) The Core competence of the corporation. *Harvard Business Review*, 68, 79-81.
- PRAHALD C.K. AND HAMEL G. (1994) Strategy as a field of study: why search for a new paradigm. *Strategic Management Journal*, 15, 5-16.
- PRATT, A. (1997) The EMerging Shape and From of Innovation Networks and Institutions. IN SIMMIE JAMES(ED.). (Ed.) *Innovation, Networks and Learning Regions?* London, Jessica Kinsley Publishers Ltd.
- PREUSS, S. A. & OXFORD BROOKES UNIVERSITY. SCHOOL OF PLANNING. (2002) *English regional planning and the regional development agencies*, Oxford, School of Planning Oxford Brookes University.

- REIN, M. & SCHON, D. (1977) Problem Setting in Policy Research: . IN C.WEISS (ED.) (Ed.) *Using social policy reserach research in public policy-making* Lexington, MA: D.C. Heath.
- RICE R.E. AND GRANT A.E. AND SCHMITZ J. AND TOROBIN J. (1990) Individual and network influences on the adoption and perceived outcomes of electronic messaging. *Social Networks*, 12, 27-55.
- ROBERTSON D. (1999) Knowledge Societies, Intellectual Capital and Economic Growth. IN GRAY HARRY (ED.) (Ed.) *Universities and the Creation of Wealth*. The Society for Reserach into Higher Education & Open University Press.
- RODRIGUES, C. & ESTEVES, C. (2000) The triple helix model as a motor for the creative use of telematics. *Research Policy*, 29, 193.
- ROOS, J., KLEINE, D. & VON KROGH, G. (1998) *Knowing in firms : understanding, managing and measuring knowledge*, London, Sage.
- ROSENBERG, N. (1982) *Inside the Black Box: Technology and Economics*, Cambridge Cambridge University Press.
- ROTHWELL, R. (1992) Successful industrial innovation: critical factors for the 1990s. *R&D Management* 22, 221-239.
- SAAD, M. (2004) Issues and challenges arising from the application of innovation strategies based on the triple helix culture. *International Journal of Technology Management & Sustainable Development*, 3, 17-34.
- SAAD, M. & ZAWDIE, G. (2005) From technology transfer to the emergence of a triple helix culture: the experience of Algeria in innovation and technological capability development. *Technology Analysis & Strategic Management*, 17, 89-103.
- SABATIER P.A. (1988) An advocacy coalition framework of policy change and the role of policy oriented learning therein. *Policy Sciences*, Vol 21, 129-68.
- SABEL C. F. (1990) *Studied Trust: Building New Forms of Cooperation in a Volatile Economy*, The MIT Press.
- SAMPSON H. (2004) Navigating the waves: the usefulness of a pilot in qualitative research. *Qualitative Research*, Vol 4, pp 383-402.
- SANCHEZ, M. P. (2000) The Design of a European Innovation Policy: Issues and Problems report for the project 'Innovation Policy in a Knoweldge-Based Economy' comissioned by teh European Commission
- SANTOS, D. (2000) Innovation and Territory. *European Urban and Regional Studies*, Vol 7.
- SAXENIAN A. (2000) Regional Networks and Innovation in Silicon Valley and Route 128. IN ACS J. Z. (ED.) (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Pinter.
- SAYER, A. (1984) *Method in Social Science: A Realist Approach*. London Hutchinson.
- SCHOFIELD J. (2001) Time for a revival? Public policy implementation: a review of the literature and an agenda for future research. *International Journal of Managemetn Reviews*, Vol 3, 245-263.
- SCHON D. (1963) *Invention and the Evolution of Ideas*, Tavistock.
- SCHUMPETER, J. (1943) *Capitalism, Socialism and Democracy*, New York, Harper Torchbooks.
- SCHUMPETER, J. (1966) *Invention and Economic Growth* New York, Cambridge Mass, Harvard University Press
- SHIELDS R. (2000) *Challenges of a knowledge based Economy: The Impact of the Knowledge Based Economy on Work in the Public Service: The Virtual Organization of Expertise and Knowledge*.

- SHINN, T. (2002) The Triple Helix and New Production of Knowledge: Prepackaged Thinking on Science and Technology. *Social Studies of Science (Sage)*, 32, 599.
- SILVERMAN, D. (1993) *Interpreting Qualitative Data: Methods for analysing talk, text and interaction* Sage Publications
- SIMMIE, J. (2004) Innovation and clustering in the globalised international economy. *Urban Studies*, 1095-1112.
- SIMMIE J. (1997) *Innovation, Networks and Learning Region*, Regional Studies Association.
- SIMMIE J. (2003) Innovation and Urban Regions as National and International Nodes for the Transfer and Sharing of Knowledge. *Regional Studies*, 37, 6&7.
- SMITH-LAWTON, H. (2000) Innovation Systems and Local Difficulties: The Oxfordshire Experience. IN ACS, J. Z. E. (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Printer.
- SMITH, K. (2000) What is the Knowledge Economy? Knowledge-Intensive industries and distributed knowledge bases. IN COMMISSION, R. P. F. I. P. I. A. K.-B. E. C. B. T. E. (Ed.), STEP Group, Oslo, Norway.
- SOH, P.-H. & ROBERTS, E. B. (2003) Networks of innovators: a longitudinal perspective. *Research Policy*, 32, 1569-1588.
- SOHAL, A., MORRISON, M. & PRATT, T. (2002) Creating a regional learning environment for accelerating company development and growth *Total Quality Management* 13, 183-194.
- STAKE R.E. (1998) Case Studies. IN DENZIN N. K. AND LINCOLN Y. S. (Ed.) *Strategies of Qualitative Inquiry*. Sage Publications.
- STAKE R.E. (2000) Case Studies. IN DENZIN N. K. AND LINCOLN Y. S. (Ed.) *Handbook of Qualitative Research*. Thousand Oaks, London, New Delhi, Sage Publications.
- STAKE, R. E. (1995) *The Art of Case Study Research* Sage Publications:Thousand Oaks.
- STRAUSS A. AND CORBIN J. (1990) *Basics of Qualitative Research*, Newbury Park, CA: Sage.
- SUTZ J. (2001) The New Role of University in the Productive Sector. IN ETZKOWITZ H. AND LEYDESDORFF L(ED). (Ed.) *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations*. London and New York, Continuum.
- TÄDTLING, F. & TRIPPL, M. (2005) One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy*, 34, 1203-1219.
- THOMPSON, G. F. (2004) Getting to know the knowledge economy *Economy and Society*, Vol 33, 562-581.
- TODTLING, F. & KAUFMAN, A. (2001) THE ROLE OF THE REGION FOR INNOVATION ACTIVITIES OF SMEs. *European Urban & Regional Studies*, 8, 203.
- TODTLING, F. & KAUFMANN, A. (1999) Innovation Systems in Regions of Europe--A Comparative Perspective. *European Planning Studies*, 7, 699.
- VAN MAANEN, J. (1979) The Fact of Fiction in organizational ethnography. *Administrative Science Quarterly*, Vol 24, pp 539-611.
- VARGA, A. (2000) Universities in Local Innovation Systems. IN ACS, J. Z. E. (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Printer.
- VOGEL, A. & KAGHAN, W. N. (2001) Bureaucrats, Brokers, and the Entrepreneurial University. *Organization*, 8, 358.
- VOLBERDA H.W. (1998) *Building the flexible: how to remain competitive*, Oxford,

Oxford University Press.

WEBSTER, A. & ETZKOWITZ, H. (2000) The future of the university and the university of the future: evolution of ivory tower. *Research Policy*, 29, 313.

WIIG, H. & WOOD, M. (1997) What comprises a regional innovation system. Theoretical Base and Indicators. IN (ED.), J. S. (Ed.) *Innovation, Networks and learning Regions*. London, Jessica Kingsley.

WILLIAM Z. TODOROVIC, ROD B. MCNAUGHTON & PAUL D. GUILD (2005) Making university departments more entrepreneurial: The perspective from within. *International Journal of Entrepreneurship & Innovation*, 6, 115-122.

WOLFE, R. A. (1994) Organizational Innovation: Review, Critique and Suggested Research Directions. *Journal of Management Studies*, 31, 405-431.

WORLD BANK (1998) Knowledge for Development World Development Report. New York: Oxford University Press.

YEUNG H. W.C. (2005) The Firm as Social Networks: An Organisational Perspective. *Growth and Change*, Vol 36, 307-328.

YIN R.K. (1981) Case Study Crisis: Some Answers. *Administrative Science Quarterly*, V26, March, pp 58-65.

YIN R.K. (1989) *Case study research: Design and methods*, Newbury Park, CA: Sage.

YIN R.K. (1994) *Case study research: Design and methods*, Sage Publications Thousand Oaks.

YIN R.K. (2003) *Case study research: Design and methods*, Sage Publications Thousand Oaks.

## Bibliography

- ABRAHAMSON E. AND ROSENKOPF L. (1997) Social Network Effects on the extent of innovation diffusion: a computer simulation. *Organization Science*, 8, 289-309.
- ACS, Z. J. & AUDRETSCH, D. B. (1993) Analyzing innovation output indicators: the US experience. IN (EDS), A. K. A. D. B. (Ed.) *New Concepts in Innovation Output Measurement*. New York, St Martin's Press.
- ACS, Z. J., MOTHE, J. D. L. & PAQUET, G. (2000) Regional Innovation: In search of an Enabling Strategy. IN (ED.), A. J. Z. (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Printer.
- ADBERNATHY W AND CLARK K. (1985) Innovation: Mapping the Winds of Creative Destruction. *Research Policy*, Vol 14, 22.
- ADLER P.A., A. P., ROCHFORD J., BURKE E.; (1998) The Politics of Participation in field research. *Urban Life*, 14, 365-376.
- AGRANOFF R. AND MCGUIRE M. (1998) Multinetwork management: Collaboration and Hollow State in Local Economic Policy. *Journal of Public Administration and Reserach and Theory*, Vol 8, 67-91.
- AGRAWAL, A. (2001) University-to-industry Knowledge Transfer: Literature Review and Unanswered Questions. *International Journal of Management Reviews*, Vol. 3 Issue 4, p285.
- AGRAWAL A. (2000) Importing Scientific Inventions: Direct Interaction, Geography, and Economic Performance,. *Mimeo, Massachusetts Institute of Technology*.
- AGRAWAL A. AND HENDERSON R. (2000) Putting patents in context: exploring knowledge transfer from MIT. *Mimeo, Massachusetts Institute of Technology*.
- AHHENAS, R., ULRICH, D., JICH, T. & HERR, S. (1995) *The Boundaryless Organization: Breaking the Chains of Organizational Structure*. Strategy and Business, Jossey-Bass Ltd.
- AHUJA, G. (2000) The Duality of collaboration: inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal*, 21, 317-343.
- AHUJA G. (2000) Collaboration Networks, Structural Holes and Innovation: A longitudinal Study:. *Administrative Science Quarterly*, 45, 425-455.
- ALDERMAN N. (2001) Innovation in low volume capital project networks: on the temporality of clustering. *Conference "The Future of Innovation Studies" Eindhoven University of Technology, The Netherlands, 20-23 September 2001*.
- ALEXANDER, J. A., COMFORT, M. B., WEINER, B. J. & BOGUE, R. (2001) Leadership in Collaborative Community Health Partnerships. *Nonprofit Management & Leadership*, 12, 159.
- AMARAVADI C.S. AND LEE I. (2005) The Dimensions of Process Knowledge. *Knowledge and Process Management*, Vol 12, pp 65-76.
- ANGROSINO M.V. AND MAYS DE PEREZ K.A. (2000) Rethinking Observation: from method to context. IN DENZIN N. K., L. Y. S. (Ed.) *The handbook of qualitative research*. Sage Publication.
- AOKI A. (1984) *The Co-operative Game Theory of the Firm*, Oxford, Clarendon Press.
- APGAR IV M. (1998) The Alternative Workplace: Changing Where and How people Work. *Harvard Business Review*, pp 121-136.
- APPEL W. BEHR R. AND G. HESSEN (1998) Towards a Theory of Virtual Organizations: A Description of their Formations and Figure. *Institute of Information Systems, Dept. of Information Management, Newsletter, Vol. 2, No 2, pp.15-36*.
- ARGYRIS C. (1970) *Intervention Theory and Method: A Behaviour Science View*, Addison-Wesley Publishing Company.
- ARGYRIS C. AND SCHON, D. (1978) *Organizational Learning: A Theory of Action Perspective*, Reading, MA - Addison - Wesley.
- ARMSTRONG M. (1999) *A handbook of human resrouce management practice*, Kogan Page Ltd.
- ARROW K.J. (1962) The Economic Implications of Learning by doing. *Review of Economic*



*Studies*, Vol 29.

ARTHUR W.B., D. J., JAWORSKI J., JUNG M., NONAKA I., SCHARMER C. O., SENGE P.M., (2002) Illuminating the Blind Spot. *Leader to Leader*, 11-14.

ASHEIM, B. T. & DUNFORD, M. (1997) regional futures. *regional Studies*, Vol 31, 445-455.

ASIAN INSTITUTE OF TECHNOLOGY. & INTERNATIONAL ASSOCIATION FOR HYDRAULIC RESEARCH ASIA AND PACIFIC REGIONAL DIVISION. (1978) *Proceedings on International conference on water resources engineering, held in Bangkok in January 10-13, 1978 ; Sponsored by Asian Institute of Technology, Canadian International Development Agency and Water Resources Planning Sub-Committee of Thailand, held under the auspices of the Asia and the Pacific Regional Division of the International Association for Hydraulic Research*, Bangkok, Asian Institute of Technology

ASSIMAKOPOULOS D. AND MACDONALD S. (2002) A dual approach to understanding information networks. *International Journal of Networking and Virtual Organization*, Vol 1, 1-17.

ATTEWELL P. (1996) Technology diffusion and organizational learning. IN MOINGEON B., E. A. (Ed.) *Organizational learning and Competitive Advantage*. London, Sage.

AUDERSTCH, D. B. & FELDMAN, M. P. (1996) R&D spillovers and the geography of innovation and production. *The American Economic Review*, 86, 630-640.

AUDRETSCH D.B. (2000) Is University Entrepreneurship Different? *Mimeo, Indiana University*.

AUDRETSCH, D. B. & LEHMANN, E. E. (2005) Does the Knowledge Spillover Theory of Entrepreneurship hold for regions? *Research Policy*, 34, 1191-1202.

AUTIO E. AND HAMERI ARI-PEKKA, A. V. O. (2004) A framework of industrial knowledge spillovers in big-science centers. *Research Policy*, Vol 33, 107-126.

AXELORD R. (1981) The emergence of cooperation among egoists. *The American Political Science Review*, 75, 306-318.

BADHAM R. (1993) Systems, Networks and Configurations: Inside the Implementation Process. *International Journal of Human Factors in Manufacturing: Special Issue*, 3.

BADHAM R. (1995) Managing Sociotechnical Change: A Configuration Approach to Technology Implementation. IN BENDERS J. AND HANN J. DE AND BENNETT D. (Ed.) *The Symbiosis of Work and Technology*.

BAKER W.E. (1992) The network organization in theory and practice. IN NOHRIA, N., ECCLES, R.G., (Ed.) *Network Organizations: structure , form and action*. Cambridge, MA: Harvard Business School Press.

BARNATT C. (1995) Office space: cyberspace and virtual organization. *Journal of General Management*.

BARNATT C. (1996) IN SEARCH OF A VIRTUAL ORGANIZATION: The Case of Cavendish Management Resources.

BARNATT C. (1996) Virtual Organizationa in the Small Business Sector: The Case of Cavendish Management Resoruces. *unpublished article*.

BARRETT, F. J. (1995) Creating Appreciative Learning Cultures. *Organizational Dynamics*, 24, 36-49.

BARRETT S. AND FUDGE C. (1981) *Policy and Action: Essays on the Implementation of Public Policy*, London, Methuen.

BARTLETT C.A. AND GHOSHAL S. (1989) *Managing Across Borders: The Transnational Solution*, Boston, MA: Harvard Business School Press.

BAUM J. AND OLIVER C. (1991) Institutional Linkages and Organizational Mortality. *Administrative Science Quarterly*, 36, 187-218.

BEATTY R.W. & ULRICH D.O. (1993) *Re-energising the Mature Organisation. Managing Change: Cases and Concepts.*, Boston, Irwin McGraw-Hill.

BECCATINI, G. (1990) The Marshallian Industrial District as socio-economic notion. IN PYKE F. BECATTINI G. AND SENGENBERGER W. (ED.). (Ed.) *Industrial Districts and Inter-firm Cooperation in Italy* Geneva International Institute for Labour Statistics

BEER M. AND EISENSTAT R.A. AND SPECTOR B. (1990) Why Change Programms Don't Produce Change. *Harvard Business Review*, Nov - Dec.

- BEGG, I. & MAYES, D. (1993) *Regional Restructuring: the case of decentralized industrial policy*, Nottingham (mimeo), Regional Science Association.
- BEIJE P. (1998) *Technological Change in the Modern Economy: Basic Topics and New Developments*, Elgar, Cheltenham.
- BELL D. (1973) *The coming of the Post Industrial Society*, New York, Basic Books.
- BELLAMY C. (1999) Exploiting Information and Communications Technologies. IN HORTON S. AND FARNHAM D. (Ed.) *Public Management in Britain*. Macmillan Press Ltd.
- BELLINI N. (2000) Planning the Learning Region: an Italian Approach. IN BOEKEMA F. AND MORGAN K. AND BAKKERS S. AND RUTTEN R. (ED.) (Ed.) *Knowledge, Innovation and Economic Growth*. Edward Elgar.
- BENEWORTH P. AND CHARLES D. (2005) University Spin-Off Policies and Economic Development in Less Successful Regions: Learning from Two Decades of Policy Practice. *European Planning Studies*, Vol 13.
- BENNER, M. & SANDSTROM, U. (2000) Institutionalizing the triple helix: research funding and norms in the academic system. *Research Policy*, 29, 291.
- BENNETT, M. (2004) Does Existing Law Fail To Address Nanotechnoscience? *IEEE Technology & Society Magazine*, 23, 27-32.
- BENNEWORTH, P. (2003) The Micro-Dynamics of Learning Networks: how local actors contest 'peripherality'. *paper presented in 'Reinventing regions in the global economy', Regional studies Association International Conference Pisa, Italy*
- BENNEWORTH, P. (2004b) Breaking the world: new technology sectors in an old industrial region. *International Journal of Biotechnology* 5, pp 249-264.
- BENNEWORTH, P. & CHARLES, D. (2005) Bringing Cambridge to Consent? Building University-centered entrepreneurial networks on peripheral regions Institute for Policy and Practice, University of Newcastle upon Tyne
- BENNEWORTH, P. & CHARLES, D. (2005) University Spin-Off Policies and Economic Development in Less Successful Regions: Learning from Two Decades of Policy Practice *European Planning Studies* 13.
- BENNEWORTH, P. & HENRY, N. (2004a) Where is the value added in the cluster approach? hermeneutic theorizing, economic geography and clusters as a multi-perspectival approach. *Urban Studies*, 1011-1023.
- BENSON, J. K. (1975) The Interorganizational Network as Political Economy. *Administrative Science Quarterly*, Vol 20, 229-249.
- BENTLEY, G. & GIBNEY, J. (2000) *Regional development agencies and business change*, Burlington, VT, Ashgate.
- BERGMAN, E., MAIER, G. & TODTLING F. (1991) Reconsidering Regions. IN BERGMAN, E., MAIER, G. & TODTLING F (ED). (Eds.) *Regions Reconsidered: Economic Networks, Innovation and Local Development in Industrialized Countries*. London: Mansell.
- BERMAN P. (1978) The Study of Macro and Micro Implementation. *Public Policy*, Vol 27, 157-184.
- BIGGS, S. & MESSERSCHMIDT, D. (2005) Social responsibility in the growing handmade paper industry of Nepal. *World Development*, 33, 1821-1843.
- BIRCHALL D. AND LYONS L. (1995) *Creating Tomorrow's Organization: Unlocking the Benefits of Future Work*, Pitman Publishing.
- BJORKENGREN C. AND RAPP B. (1999) Learning and knowledge management: theoretical framework for learning in flexible organizations. IN JACKSON P.J. (Ed.) *Virtual working: social and organizational dynamics*. London and New York, Routledge.
- BLACKLER F. (1995) Knowledge, Knowledge work and Organizations: an overview and interpretation. *Organization Studies*, 16, 1021-1046.
- BLIND KNUT AND GRUPP HARIOLF. (1999) Interdependencies between the science and technology infrastructure and innovation activities in German regions: empirical findings and policy consequences. *Research Policy*, 28, 451-468.
- BLOOMFIELD B. AND COOMBS R. (1992) Information Technology, Control and Power. *Journal of Management Studies*, 29.
- BLOOMFIELD B. AND COOMBS R. AND KNIGHTS D. AND LITTLER D. (1997)

*Information Technology and Organizations: Strategies, Networks and Integration.*

- BLUM F.H. (1952) Getting individuals to give information to the outsider. *Journal of Social Issues*, 35-42.
- BLUMER H. (1969) *Symbolic Interactionism*, Englewood Cliffs, NJ, Prentice-Hall.
- BODDY D. AND GUNSON N. (1996) *Organizations in the network age*, London and New York, Routledge.
- BOGASON P. (1991) Control for whom? recent adventures on governmental guidance and control. *European Journal of Political Research*, Vol 20, 189-208.
- BONGSUG CHAE, PARADICE, D., KOCH, H. & VO VAN HUY (2005) Exploring Knowledge Management Using Network Theories: Questions, Paradoxes and Prospects. *Journal of Computer Information Systems*, 45, 62-74.
- BOOMS, B. H. A. B. M. J. (1981) Marketing Strategies and Organizational Structures for Firms. IN DONNELLY J. AND GEORGE W. (Ed.) *Marketing of Services*. Chicago: American Marketing Association, quoted in Zeithaml, V. and Bitner, M. (1996) *Services Marketing*, New York: McGraw -Hill.
- BORINS, S. (2001) Public Management Innovation: Toward a Global Perspective 10.1177/02750740122064802. *The American Review of Public Administration*, 31, 5-21.
- BOSCHMA, R. A. (1999) The rise of clusters of innovative industries in Belgium during the industrial epoch. *Research Policy*, 28, 853-871.
- BOSTON M. (1998) *Harvard Business Review on Change*, Harvard Business School.
- BOTTAZZI, L. & PERI, G. (2003) Innovation and spillovers in regions: Evidence from European patent data. *European Economic Review*, 47, 687.
- BOUMA, G. D. (2000) *The Research Process*, Oxford University Press.
- BRADACH J.L. AND ECCLES R.G. (1989) Price, Authority and Trust: From Ideal Types to Plural Forms. *Annual Review of Sociology*, 15, 97-118.
- BRAMAN S. (1989) Defining information: An Approach for policymakers. *Telecommunications Policy*, September, pp233-242.
- BRANNIEN, J. E. S. A. M. Y. (2000) NATIONAL CULTURE, NETWORKS, AND INDIVIDUAL INFLUENCE IN A MULTINATIONAL MANAGEMENT TEAM. *Academy of Management Journal*, v43 i2, p191.
- BRAUN, D. (1998) The role of funding agencies in the cognitive development of science. *Research Policy*, 27, 807-821.
- BREWER A. M. AND HENSHER D.A. (1998) Flexible Work and Travel Behaviour. IN JACKSON P.J. AND VENDER WEILEN J. (ED) (Ed.) *Teleworking: International Perspectives: from Telecommuting to the virtual organization*. London, Routledge.
- BRGHAM M. AND CORBETT M. (1996) Trust and the Virtual Organization: Handy Cyberia. IN JACKSON, P. J. A. V. D. W. J. (Ed.) *Proceedings of the Workshop : New International Perspectives on Telework: From Telecommuting to the Virtual Organization*. London 31 July - 2nd August 1996, Tilbury, The Netherlands: Tilburg University Press.
- BROWN J. S. AND DUGUID P. (2000) *The Social Life of Information*, Harvard Business School Press.
- BROWN J.S. AND DUGUID P. (1991) Organizational Learning and Communities of Practice: Towards a Unified View of Working, Learning and Innovation. *Organization Science*, 2, 40-57.
- BROWN J.S. AND DUGUID P. (1998) Organizing Knowledge. *California Management Review*, 40, 90-111.
- BRUIJN J.A. DE AND HEUVELHOF E.F. TEN. (1997) Instruments for Network Management. IN KICKERT J.M. WATER. AND KLIJN ERIK-HANS (Ed.) *Managing Complex Networks: Strategies for the Public Sector*. Sage Publication Ltd.
- BRUSCO, S. (1990) The Idea of the Industrial District: its genesis. IN PYKE F. BECATTINI G. AND SENGENBERGER W. (ED.). (Ed.) *Industrial Districts and Inter-Firm Cooperation in Italy*. Geneva, International Institute for Labour Statistics.
- BUCHANAN D. AND BODDY D. AND MCCALMAN J. (1988) Getting in, Getting on, Getting out and Getting Back. IN BRYMAN A. (ED.) (Ed.) *Doing Research in Organizations*. Routledge.

- BUCHANAN D., B. D., MCCALMAN J., (1988) Getting in, getting on, getting out and getting back. IN BRYMAN A. (Ed.) *Doing Research in Organizations*. London and New York, Routledge.
- BURGESS R.G. (1984) *In the field: An introduction to field research*, London, Allen & Unwin.
- BURGESS, R. G. (1991) *In the Field, An Introduction to Field Research* Sage
- BURKHARDT M.E. AND BRASS D.J. (1990) Changing patterns or patterns of change: the effects of a change in technology on social network structure and power. *Administrative Science Quarterly*, 35, 104 - 127.
- BURNES, B. No such thing as...a 'one best way' to manage organizational change. *Management Decision*, 34, 11.
- BURNS T. AND STALKER G.R. (1961) *The Management of Innovation*, London, Tavistock.
- BURRELL G. AND MORGAN G. (1979) *Sociological Paradigms and Organizational Analysis*, Ashgate Publishing Limited.
- BURT R.S. (1978) Cohesion versus structural equivalence as a basis for network subgroups. *Sociological Methods and Research*, 7, 189-212.
- BURT R.S. (1997) The contingent value of social capital. *Administrative Science Quarterly*, 42, 339-365.
- BUTLER J.E., B. B., CHAMORNARN W., (2000) Guanxi and the Dynamics of Overseas Chinese Entrepreneurial Behavior in Southeast Asia. IN LI J.T., T. A. S., WELDON E., (Ed.) *Management and Organization in the Chinese Context*. Macmillan Press Ltd.
- CALAS M.B., S. L. (1992) Using the 'F' word: feminist theories and the social consequences of organizational research. IN MILLS A.J., T. P. (Ed.) *Gendering Organizational Analysis*. London, Sage.
- CALVIN J. (2005) Major events, networks and regional development. *Regional Studies*, Vol 39, 185.
- CAMAGNI R. (1993) Inter firm industrial networks: the costs and benefits of cooperative behaviour. *Journal of Industrial Studies*, 1, 1-15.
- CAMPBELL A. (1999) Knowledge Management in the web enterprise. IN JACKSON P.J. (Ed.) *Virtual Working: Social and Organizational Dynamics*. London and New York, Routledge.
- CAMPBELL A. AND GRANTHAN C. (1998) Organizational Assessment in The Distributed Work Environment. IN JACKSON P.J. AND VENDER WEILEN J. (ED) (Ed.) *Teleworking: International Perspectives: from Telecommuting to the virtual organization*. London, Routledge.
- CAMPBELL D.T. (1975) Degrees of Freedom and Case Study. *Comparative Political Studies*, 8.
- CAMPBELL, E. G., POWERS, J. B., BLUMENTHAL, D. & BLIES, B. (2004) Inside the Triple Helix: Technology Transfer And Commercialization In The Life Sciences. *Health Affairs*, 23, 64-76.
- CAMPELL A (1997) *Creating a Virtual Corporation and Managing the Distributed Workforce*, University of Paisley, Paisley, U.K.
- CARAYANNIS, E. G., POPESCU, D., SIPP, C. & STEWART, M. (2006) Technological learning for entrepreneurial development (TL4ED) in the knowledge economy (KE): Case studies and lessons learned. *Technovation*, 26, 419-443.
- CAREY S. (1991) Knowledge acquisition: enrichment or conceptual change? IN (EDS.), S. C. R. G. (Ed.) *The Epigenesis of Mind: Essays in Biology and Cognition*. Hillsdale, NJ: Erlbaum.
- CAROLI, E. & VAN REENEN, J. (1999) Organization, Skills and technology: evidence from a panel of British and French Establishments. *IFS Working Papers*, W99/23, Institute for Fiscal Studies.
- CASEY, C. (1995) *Work, Self and Society after Industrialism*, London, Routledge.
- CASEY, C. (2004) Knowledge-Based Economies, Organizations and the Sociocultural Regulation of Work  
10.1177/0143831X04047161. *Economic and Industrial Democracy*, 25, 607-627.

- CASPER S. AND KETTLER H. (2001) National institutional Frameworks and the Hybridization of Entrepreneurial Business Models: The German and UK Biotechnology Sectors. *Industry and Innovation*, 8, pp. 5-30.
- CASTELLS M. (2001) *The Internet Galaxy: reflections on the internet, business and society*, Oxford, University Press.
- CAWKELL A.E. (1987) *Evolution of an Information Society*, London, Aslib.
- CBI (CONFEDERATION OF BRITISH INDUSTRY). (1999) Summary progress report: information age partnership working group on ITEC clusters. London, CBI.
- CHAKRAVARTHY B.S, D. Y. (1992) Strategy process research: focusing on corporate self-renewal. *Strategic Management Journal*, 13, 5-14.
- CHARLES, D. (2003) Universities and Territorial Development: Reshaping the Regional Role of UK Universities *Local Economy* 18, 7-20.
- CHARLES, D. & BENNEWORTH, P. (2001) Clustering and Economic Complexity: Regional ICT Clusters in the United Kingdom. IN BERGMAN, E., CHARLES, D. & HERTOOG (ED), P. D. (Eds.) *Innovative Clusters: Drivers of National Innovation Systems*. OECD Proceedings.
- CHARLES, D. & HOWELLS, J. (1992) *Technology Transfer in Europe: Public and Private Networks*, London: Belhaven.
- CHELL E., S. B. (2000) Networking, entrepreneurship and microbusiness behaviour. *Entrepreneurship & Regional Development*, 12, 195-215.
- CHESBROUGH H. W. AND TEECE D.J. (1996) When is Virtual Virtuous: Organizing for Innovation. *Harvard Business Review*, Jan -Feb.
- CHILD J. (1987) Information Technology, Organization and the Response to Strategic Challenges. *California Management Review*, Fall, 33-50.
- CHILD J., F. D. (1998) *Strategies of Cooperation: Managing Alliance, Networks and Joint Ventures*, Oxford University Press.
- CHRISTENSEN, C. (1997) *The Innovator's Dilemma*, Harper Collins.
- CHRISTY RICHARD AND BROWN JILL (1999) Marketing in the Public Services. IN HORTON S. AND FARNHAM D. (Ed.) *Public Management in Britain*. Macmillan Press Ltd.
- CIBORRA C. (1996) The Platform Organization: Recombining Strategies, Structures, and Surprises. *Organization Science*, Vol 7, 103-118.
- CIMOLI M. AND CONSTANTINO R. (2000) Systems of innovation, knowledge and networks: Latin America and its capability to capture benefits. IN LOPEZ-MARTINEZ R.E. AND PICCALUGA A. (Ed.) *Knowledge flows in National Systems of Innovation*. Edward Elgar Publishing Ltd.
- CLAMPITT G. P. (2001) *Communicating for Managerial Effectiveness*, Sage Publications Inc.
- CLARK B.R. (1992) Creating Entrepreneurial Universities: Organizational Pathways of Transformation. *Higher Education*, Vol 12, London.
- CLARK, B. R. (1992) *Creating Entrepreneurial Universities: Organizational Pathways of Transformation* London Pergamon Press.
- CLARK PETER A. (1999) *Organizations in action : competition between contexts*, London, Routledge.
- CLASES C. AND BACHMANN R., A. W. T. (2003) Studying Trust in Virtual Organizations. *International Journal of Management and Organizations*, Vol 33, 7-27.
- COATES D. AND WARWICK K. (1999) The Knowledge Driven Economy: Analysis and Background. *Papers presented at a conference jointly organized by the Department of Trade and Industry and the Centre for Economic Policy Research, 27 January 1999*. London.
- COATES J.F. (1994) Managing Scientists in the Virtual Corporation. *Research -Technology Management*, Vol 37. No 6, 7-8.
- COBBENHAGEN, J. & SEVERIJNS, J. (1999) Towards a Knowledge-Intensive Regional Economy. IN KEVIN MORGAN AND CLAIRE NAUWELAERS (EDS) (Ed.) *Regional Innovation Strategies: The Challenge for Less-Favored Regions*. Routledge Taylor & Francis Group.
- COCCIA, M. (2004) Spatial Metrics of the Technological Transfer: Analysis and Strategic

- Management. *Technology Analysis & Strategic Management*, 16, 31-51.
- COCKBURN I. AND HENDERSON R. (1998) Absorptive Capacity, coauthoring behaviour, and the organizational of research in drug discovery. *Journal of Industrial Economics*, XLVI, 157-182.
- COHEN, S. S. & FIELDS, G. (1999) Social capital and capital gains in Silicon Valley: . *California Management Review* 41, 108-130.
- COHEN W.M. AND LEVINTHAL D.A. (1990) Absorptive Capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 35, 128-152.
- COLIN M; HUGH L; (2000) *Leadership examined : knowledge and activities for effective practice*, London, Stationery Office.
- COLLINS H. (1993) The structure of knowledge. *Social Research*, 60, 95-116.
- COLLINS, J. C. & PORRAS, J. I. (1996) Building your company's vision *Harvard Business Review*, VOL 74, 65-77.
- COLYVAS, J., CROW, M., CGELIJINS, A., MAZZOLENI, R., NELSON, R. R., ROSENBERG, N. & SAMPAT, B. N. (2000) How do university inventions get into practice. *Mimeo, Stanford University*.
- CONRAD M. (1996) Cross scale information processing in evolution, development and intelligence. *Biosystems*, 38, 97-109.
- COOKE, P. (2000) *Business Processes in Regional Innovation System in the European Union*, London and New York, Pinter.
- COOKE, P. (2001) Regional Innovation Systems, Clusters, and the Knowledge Economy. *Industrial & Corporate Change*, 10, 945-974.
- COOKE, P. (2004) The role of research in regional innovation systems: new models meeting knowledge economy demands. *International Journal of Technology Management*, 28, 507-533.
- COOKE, P. (2005) Regionally asymmetric knowledge capabilities and open innovation: Exploring 'Globalization' - A new model of industry organization. *Research Policy*, 34, 1128-1149.
- COOKE, P. & MORGAN, K. (1998) *The Associational Economy*, London, Oxford University Press.
- COOKE P AND MORGAN K. (1998) *The Associational Economy, Firms, Regions and Innovation*, Oxford, University Press, Oxford, UK.
- COOKE P. (1998) Regional Innovation System - an evolutionary approach. IN COOKE P. AND HEIDENREICH M. AND BRACZYK HANS-JOACHIM (ED.) (Ed.) *Regional Innovation Systems: the role of governance in a globalized world*. London, Routledge.
- COOKE P. (2002) *Knowledge Economies: Clusters, Learning and Cooperative Advantage*, London, Routledge.
- COOKE P. AND MORGAN K. (1991) *The Network paradigm : new departures in corporate and regional development*, Cardiff, Regional Industrial Research.
- CORNFORD J. AND MCLOUGHLIN I.P. AND WESSELS B. (2001) Exploring new concepts of integration in public service: rethinking information system and organizational architectures. *17th European Group for Organizational Studies*. Lyon France.
- CORSO, M., MARTINI, A., PAOLUCCI, E. & PELLEGRINI, L. (2001) Knowledge Management in Product Innovation: An Interpretative Review. *International Journal of Management Reviews*, Vol. 3 Issue 4, p341.
- CRAY D. AND MALLORY G. (1998) *Making sense of managing culture*, London, International Thomson Business Press.
- CRESWELL J. W. (2003) *Research Design: Qualitative, quantitative, and mixed method approach*, Sage Publications.
- CRESWELL J.W. (1994) *Qualitative inquiry and research design: choosing among five traditions*, Thousand Oaks, CA: Sage.
- CROOMBS R., A. R. A., AND SAVIOTTI P. AND WALSH V., (1996) Introduction: Technological Collaboration and networks of alliances in the innovation process. IN COOMBS R., R. A., SAVIOTTI P., AND WALSH V. (Ed.) *Technological Collaboration: The Dynamics of Cooperation in Industrial Innovation*, Cheltenham, Edward Elgar.

- CROZIER M. (1964) *The Bureaucratic Phenomenon*, Chicago, University of Chicago Press.
- CSSA. (1997) The response of computing services and software association to the Public Consultation on government. direct. <http://www.open.gov.uk/citu>.
- CURDS (2004) *Reginal Science Policy & Instruments: an overview of British Developments*. Centre for Urban & Regional Development Studies.
- CUTCHER-GERSHENFELD, J. (1998) *Knowledge-driven work : unexpected lessons from Japanese and United States work practices*, New York, Oxford University Press.
- CZARNIAWSKA-JOERGES B. (1992) *Exploring Complex Organizations*, Sage Publications.
- DAFT L. R. AND LEGEL R.H. (1986) Organizational Information Requirement, Media Richness and Structural Design. *Management Science*, May,, pp554-571.
- DAFT R.L.AND LEWIN A.Y. (1993) Where are the theories for the new organizational forms? *Organization Science*, 4, i-vi.
- DAFT, R. L. & LENGEL, R. H. F. (1998) *Leadership: Unlocking the Subtle Forces That Change People and Organizations.*, San Francisco: Berrett-Koehler.
- DANKBAAR B. (2004) Embeddedness, Context , Proximity and Control. *European Planning Studies*, Vol 12.
- DANSEREAU F. AND YAMMARINO F. J. AND KOHLES J.C. (1999) Multiple Levels of Analysis from a Longitudinal Perspective: some implications for theory building. *Academy of Management Review*, Vol 24, pp 346-357.
- DAVENPORT T. (1995) The Virtual and the Physical. *CIO*, November 36-38.
- DAVENPORT T. AND PEARLSON K. (1998) Two Cheers for the Virtual Office. *Sloan Management Review*, Vol 39, 51-65.
- DAVENPORT T.H. (1994) Saving IT's soul: human centred information management. *Harvard Business Review*, 72, 119-131.
- DAVENPORT T.H. AND ECCLES R.G AND PRUSAK L. (1992) Information Politics. *Sloan Management Review*, Fall.
- DAVENPORT, T. H. A. P., LAURENCE., (1998) *Working knowledge : how organizations manage what they know*, Boston, Mass, Harvard Business School Press.
- DAVID, P. A. F., D. (1995) Assessing and Expanding the Science and Technology Knowledge Base. *STI Review*, . 16.
- DAVIDOW W.H. AND MALONE M.S. (1992) *Virtual Corporation: Structuring and Revitalizing the Corporation of the 21st Century*, New York, Harper Business.
- DAVIDS G. (1995) *A government of routines: executive coordination in an Australian state*, Melbourne, Macmillan Education.
- DE DREU C AND VAN DE VLIERT E. (1997) *Using Conflict in Organizations*. Sage Publications, London.
- DE MIRANDA, A. (2003) Total Quality Management and Inequality: The Triple Helix in Global Historical Perspective. *Science, Technology & Human Values*, 28, 34.
- DEBRESSON C. AND AMESSE F. (1991) Networks of Innovators: a synthesis of research issues. *Research Policy*, Vol 20, 363-79.
- DELBRIDGE, R. (2003) Knowledge, innovation and institutional change
- DEMBSKI T (1998) Future Present: The Concept of Virtual Organization revisited the Nature of Boundedness of Virtual Organizations. *Virtual-Organization.Net Newsletter, Institute of Information Systems, Department of Information Management, University of Berne.*, Vol. 2, No 2, pp. 37-58.
- DEN HAMER, L. F. & BOUROCHE, M. A. (2001) Academic Capitalism. Politics, Policies, and the Entrepreneurial University (Book Review). *Journal of Research Administration*, 2, 33.
- DENYER, D. & NEELY, A. (2004) Introduction to special issue: Innovation and productivity performance in the UK. *International Journal of Management Reviews*, Vol. 5/6 Issue 3/4, p131-135.
- DENZIN, N. & LINCOLIN, Y. (1994) *Handbook of Qualitative Research* Thousand Oaks, CA: Sage
- DENZIN N. K. AND LINCOLN Y. S. (1998) *Strategies of Qualitative Inquiry*, Sage

Publications.

- DEPICKERE A. (1999) Managing virtual working: between commitment and control. IN JACKSON P.J. (Ed.) *Virtual Working: social and organizational dynamics*. London & New York, Routledge.
- DICKSON K., L. S., LLOYD S., (1991) Bridge over troubled waters? Problems and opportunities in inter-firm research collaborations. *Technology Analysis and Strategic Management*, 33, 143-56.
- DODGSON M. (1996) Learning, Trust and Inter-Firm technological linkages: some theoretical associations. IN COOMBS R., R. A., SAVIOTTI P., AND WALSH V. (Ed.) *Technological Collaboration: The Dynamics of Cooperation in Industrial Innovation*, Cheltenham, Edward Elgar.
- DONALDSON G AND LORSCH J.W. (1983) *Decision-making at the Top: The Shaping of Strategic Direction*, New York, Basic Books.
- DORAY P AND TREMBLAY DIANE-GABRIELLE; (2002) Cooperation as a means of production and diffusion of knowledge: theoretical perspectives and an empirical case study. IN NAMAMURA, M. (Ed.) *Alliance, Cooperative Ventures and The Role of Government in the Knowledge Based Economy*. The Centre of Japanese Research, The University of British Columbia.
- DOUGHERTY, D. (2004) Organizing Practices in Services: Capturing Practice-Based Knowledge for Innovation 10.1177/1476127004040914. *Strategic Organization*, 2, 35-64.
- DOUTRIAUX, J. (2003) University-Industry Linkages and the Development of Knowledge Clusters in Canada. *Local Economy*, Vol 18, 63-79.
- DOZ, Y. L. A. H., G. (1998) *Alliance Advantage: The Art of Creating Value Through Partnering*, Boston: , Harvard Business School Press.
- DRAHOS P. AND BRAITHWAITE J; (2002) *Information Feudalism: Who Owns The Knowledge Economy?*, Earthscan.
- DRAZIN, R. & SCHOONHOVEN, C. B. (1996) Community, population and organization effects on innovation: a multilevel perspective. *Academy of Management Journal*, 39, 1065-1083.
- DRETSK F. L. (1981) *Knowledge & the flow of information*, Cambridge, MIT Press.
- DRUCKER P. (1988) The Coming of the New Organization. *Harvard Business Review*, Jan-Feb,, pp 45-53.
- DRUCKER P.F. (1993) *Post-Capitalist Society*, Oxford : Butterworth Heinemann.
- DRUCKER P.F. (1997) Introduction: Towards the New Organization. IN HESSELBEIN, F., M. GOLDSMITH AND R. BECKHARD, (Ed.) *The Organization of the Future*, Jossey-Bass Publishers, San Francisco, pp. 1-5.
- DTI <http://www.innovation.gov.uk/innovationreport>
- DTI (2000) Excellence and Opportunity- A Science and Innovation Policy for the 21st century, White Paper (Cm4841). *The Stationery Office, London*
- DTI (no date ) Clusters: Higher Education and Business Collaboration for Success. *Department of Trade and Industry London*
- DTI. (2002) Competing in Global Economy - The Innovation Challenge. London, DTI Economics Paper No 7.
- DUNKERLY D. (1988) Historical methods and organization analysis: the case of a naval dockyard. IN BRYMAN A (ED.). (Ed.) *Doing Research in Organizations*. Routledge.
- DUNPHY, D. C. Transformational and Coercive Strategies for Planned Organizational Change: Beyond the O.D. Model. *Organization Studies (Walter de Gruyter GmbH & Co. KG)*, 9, 317-334.
- EARL M J AND SCOTT I. A. (1999) Opinion What is a Chief Knowledge Officer. *Sloan Management Review*, Winter, pp 29-38.
- EASTERBY-SMITH M. THORPE R. AND LOWE A. (2002) *Management Research: An Introduction*, Sage Publication; London.
- EASTON G., A. L. (1994) Market exchange, social structures and time. *European Journal of Marketing*, 28, 72-84.
- EDQUIST, C. & JOHNSON, B. (1997) Institutions and Organization in Systems of



- Innovation IN (ED.), C. E. (Ed.) *Systems of Innovation -Technologies, Institutions and Organizations*. London/washington, Printer
- EDWARDS N. P. (1995) From impact to social process; computers in society and culture. IN JASANOFF S. AND MARKTE GE. AND PETERSEN J.C. AND PINCH T. (Ed.) *Handbook of Science and Technogy Studeis*.
- EICKELPASCH, A. & FRITSCH, M. (2005) Contests for cooperation A new approach in German innovation policy. *Research Policy*, 34, 1269-1282.
- EISENHARDT, K., KAHWAJY, J. L. & BOURGEOIS, L. J. I. (1997) How Management Teams Can Have A Good Fight. *Harvard Business Review*, Jul-Aug, n4.
- ERAUT, M. (1996) *Skills, Competence and Transfer: Towards Clarifying meanings and Inferences and a New Conceptual framework*, University of Sussex.
- ETZKOWITZ, H. (1998) The norms of entrepreneurial science: cognitive effects of the new university-industry linkages. *Research Policy*, 27, 823-833.
- ETZKOWITZ, H. (2002) Networks of Innovation: Science, Technology and Development in the Triple Helix Era. *International Journal of Technology Management & Sustainable Development*, 1, 7.
- ETZKOWITZ, H. & LEYDESDORFF, L. (2000) The dynamics of innovation: from National Systems and 'Mode 2' to a Triple Helix of university. *Research Policy*, 29, 109.
- ETZKOWITZ, H., MELLO, J. M. A. D. & ALMEIDA, M. (2005) Towards "meta-innovation" in Brazil: The evolution of the incubator and the emergence of a triple helix. *Research Policy*, 34, 411-424.
- ETZKOWITZ, H. & WOLFF, M. F. (2000) Tech Transfer, Incubators Probed at Triple Helix III. *Research Technology Management*, 43, 4.
- ETZKOWITZ H. AND LEYDESDORFF L. (1997) Introduction to special issues on science policy dimensions of the Triple Helix of University-industry-government relations. *Science & Public Policy*, Vol 24.
- ETZKOWITZ H. AND LEYDESDORFF L. (2001) *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations*, London and New York, Continuum.
- ETZKOWITZ H. AND WEBSTER A. (2000) The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Research Policy*, Vol 29, 313-330.
- FEAGIN J. R. AND ORUM A. M. AND SJOBERG G. (1991) *A Case for the Case Study*, Univeristy of North Carolina Press.
- FELDMAN, M. (1994) *The Geography of Innovation* Boston Kluver Academic
- FELDMAN, M. & FLORIDA, R. (1994) The Geographic sources of innovation: technological infrastructure and product innovation in the United States *Anal of the Association of America Geographers* 84.
- FELDMAN M AND FRANCIS J. AND BERCOVITZ J. (2005) Creating a cluster while building as firm:Entrepreneurs and the formation of industry clusters,. *Regional Sciences*, Vol. 39, 129-142.
- FELSENSTEIN, D. (1996) The University in the Metropolitan Arena: Impacts and Public Policy Implications. *Urban Studies*, Vol 33, 1565-1580.
- FERLIE, E., PETTIGREW, A., ASHBURNER, L. & FITZGERALD, L. (1996) *The new public management in Action*, Oxford, Oxford University Press.
- FESER E. J. AND BERGMAN E.M. (2000) National industrial cluster templates: a framework for applied regional cluster analysis. *Regional Studies*, 34, 1-20.
- FISHER A. (1993) *A global concept -Virtual companies*, Financial Times, pp 12, 16 July 1993.
- FISHER D. (1993) *Communication in Organizations*. West Publishing Company;, St. Paul.
- FISHER K. AND FISHER M.D. (1998) *The Distributed Mind: Achieving High Performance Through the Collective Intelligence of Knowledge Work Teams*, American Management Association.
- FITLOG (1998) *Community Governance in the Information Society*, London : Foundation for IT in Local Government.

- FLECK; (1983) The effective utilization of robots: the management of expertise and know how. *Proceedings of the 6th British Robot Association Annual Conference*, Birmingham, 61-69.
- FLEMING, L. & JUDA, A. (2004) A Network of Invention. *Harvard Business Review*, 82, 22-22.
- FLICK U. (1992) Triangulation Revisited: Strategy of validation or Alternative. *Journal for the Theory of Social Behaviour*, 22, 175-198.
- FORNAHL D. AND BRENNER T. (2003) *Cooperation, Networks, and Institutions in Regional Innovations Systems*, Cheltenham: Edward Elgar.
- FORTANA A., F. J. H. (2000) The interview: from structured questions and negotiated text. IN DENZIN N. K., L. Y. S. (Ed.) *Handbook of Qualitative Research*. Thousand Oaks, London, New Delhi, Sage Publications.
- FOSBERG D.A. (1995) The yin and yang of managing in Asia. *HR Magazine*, 40, 76 (5).
- FOUNTAIN J. (2001) *The Virtual State*.
- FOWLES, S. & CLARK, W. W. (2005) Innovation networks: good ideas from everywhere in the world. *Strategy & Leadership*, 33, 46-50.
- FOX, A. (1974) *Beyond Contract: Work, Power and Trust Relations* London: Farber and Farber
- FRANKE ULRICH J. (2002) *Managing virtual web organizations in the 21st century : issues and challenges*, Hershey, PA, Idea Group Pub.
- FRASER, A. (1999) Case Study: Inward Investment in the UK. *East-West Centre*.
- FRASER D. (1999) Universities and Communities: Cases from North-East England. IN GRAY HARRY (ED.) (Ed.) *Universities and the Creation of Wealth*. The Society for Research into Higher Education & Open University Press.
- FREDRICKA, J. (2000) Bridge Building: Enhancing the Possibility of Partnerships *Journal for Quality & Participation* May/June 39-43.
- FREEMAN RICHARD B. AND ROGERS JOEL. (1999) *What Workers Want*, Russell Sage Foundation New York.
- FRENKEL, A. (2000) Can regional policy affect firms' innovation potential in lagging regions? *Annals of Regional Science*, 34, 315.
- FRITSCH, M. & STEPHAN, A. (2005) Regionalization of innovation policy Introduction to the special issue. *Research Policy*, 34, 1123-1127.
- FROMHOLD-EISEBITH, M. & EISEBITH, G. (2005) How to institutionalize innovative clusters? Comparing explicit top-down and implicit bottom-up approaches. *Research Policy*, 34, 1250-1268.
- FROST P. AND MORGAN G. (1983) Symbols and sense making: the Realization of a framework. IN PONDY L. R. AND FROST P.J. AND MORGAN G. AND DANDRIDGE T.C. (Ed.) *Organizational Symbolism*. Greenwich, JAI Press.
- FUKUYAMA F. (1995) *Trust: The Social Virtue and the Creation of Prosperity*, London, Hamish Hamilton.
- FULK J AND BOYD B. (1991) Emerging Theories of Communication in Organization; *Journal of Management*, V 17, pp407 -446.
- FULLER M. (1993) Dimensions of Gender in a School: Reinventing the Wheel? IN BURGESS B., E. (Ed.) *The Research Process in Educational Settings: Ten Case studies*. London, The Falmer Press.
- GABARRO J. (1990) The development of working relationships. IN GALEGHER J., K. R. E., AND EGIDO C., (Ed.) *Intellectual Work: the social and technological bases of cooperative work*. Hillsdale, NJ: Erlbaum.
- GABRIEL Y. FLINEMAN S. AND SIMS D. (1992) *Organizing and Organizations*, Sage Publication Ltd.
- GADAMER, H. G. (1976) *The History of Understanding: In critical sociology, selected readings*, Connerton P (ed), Penguin Books Ltd; Harmondsworth;
- GALBRAITH J. (1973) *Designing Complex Organizations*, Reading, MA: Addison Wesley.
- GEBAUER, A., CHANG WOON NAM & PARSCHE, R. D. (2005) Regional technology policy and factors shaping local innovation networks in small German cities1. *European*

*Planning Studies*, 13, 661-683.

GEBHARDT, C., POHLMANN, M. & ETZKOWITZ, H. (2004) Preface: The global paradigm of networking as an underlying rationality of programming innovation policies. *International Journal of Technology Management*, 27, 431-439.

GEORGHIOU, L. (1998) Issues in the Evaluation of Innovation and Technology Policy. *Evaluation*, 4, 37-51.

GERLACH N. AND HAMILTON S. (2000) Telling the Future, Managing the Present: Business Restructuring Literature as SF. *Science Fiction Studies*, Vol. 27, pp. 461-477.

GEROSKI P. AND GREGG P. (1994) Corporate restructuring in the UK during the recession. *Business Strategy Review*, 5, 1-19.

GHOSHAL S. AND BARTLETT C. (1990) The multinational corporation as an interorganizational network. *Academy of Management Review*, 15, 603-625.

GHOSHAL S. AND NOHRIA N. (1993) Horses for courses: organizational forms for multinational corporations. *Sloan Management Review*, 23-35.

GIDDEN A. (1984) *The Constitution of Society: Outline of the Theory of Structuration*, London, Macmillan.

GIESECKE, S. (2000) The contrasting roles of government in the development of biotechnology industry in the US and. *Research Policy*, 29, 205.

GILL P.; STEWART C; (1996) *The politics of management knowledge*, London, Sage.

GILMORE A. AND CARSON D. (1996) "Integrative" qualitative methods in a services context. *Marketing Intelligence & Planning*, June 1996 v14 n6 p21(6).

GILSINAN J; (1984) Information and Knowledge development potential: The Public vs. Private Jobs Demonstration Project. *Evaluation Review*, 8(3): 371-388.

GLASER, B. (1978) *Theoretical Sensitivity: Advances in the Methodology of Grounded Theory*, Mill Valley, CA: Sociology Press.

GLEGG STWEART R. (1990) *Modern Organizations: Organizational Studies in teh Postmodern World*, London, Sage.

GLODMAN S. AND NAGEL N. AND PREISS K. (1995) *Agile Competitors and Virtual Organizations*, Van Nostrand Reinhold.

GLYNN M.A. (1996) Innovative Genius: A Framework for Relating Individual and Organizational Intelligence to Innovation. *Academy of Management Review*, 21, 1081-1111.

GODIN, B. (2003) The Knowledge-Based Economy: Conceptual Framework or Buzzword? *Project on the History and Sociology of S&T Statistics. Working Paper*.

GOH, A. L. S. (2005) Promoting innovation in aid of industrial development: the Singapore an experience. *International Journal of Public Sector Management*, 18, 216-240.

GOLDHOR, R. S. & LUND, R. T. (1983) University to industry advanced technology transfer: A case study. *Research Policy*, Vol 12, 121-152.

GOMES-CASSERES, B. (1994) Group versus group: how alliance networks compete:. *Harvard Business Review*, July/august, 62-74.

GOODMAN P.S. AND SPROULL L.S. (1990) *Technology and Organizations*, Oxford, San Francisco, Jossey-Bass Publishers.

GORDDARD J. (1997) Universities and Regional Development: An Overview. IN BACKGROUND PAPER TO OECD PROJECT ON THE RESPONSE OF HIGHER EDUCATION TO REGIONAL NEEDS (Ed.), Centre for Urban and Regional Development Studies, University of Newcastle upon Tyne.

GORDON F.M. (1994) Bureaucracy: Can We do better? We can do worse. IN C. HECKSCHER, A. A. D. (Ed.) *The Post-Bureaucratic Organization: New Perspectives on Organizational Change*. Thousand Oaks, CA: Sage,.

GRANOVETTER, M. (1985) Economic action and social structure: the problem of embeddness. *American Journal of Sociology* 21, 481-510.

GRANOVETTER M.S. (1973) The strength of weak ties. *American Journal of Sociology*, 78, 1360-1380.

GRANOVETTER M.S. (1982) The strength of weak ties: a network revisited. IN P. MARSDEN, N. L. (Ed.) *Social Structure and Network Analysis*. Beverly Hills, CA: Sage.

GRANOVETTER M.S. (1985) Economic action and social structure: the problem of

- embeddedness. *American Journal of Sociology*, Vol 91, 481-510.
- GRANT R.M. (1996) Toward a Knowledge-based theory of the firm. *Strategic Management Journal*, 17, 109-122.
- GRAY, B. (1989) *Collaborating: Finding Common Ground for Multiparty Problem*, Sanfransisco CA, Jossey-Bass.
- GRAY, B. (1989) *Collaborating: Finding Common Ground for Multiparty Problems.* , San Francisco, Jossey-Bass.
- GRAY H. (1999) *Universities and the Creation of Wealth*, The Society for Research into Higher Education & Open University Press.
- GRENIER R. AND METES G. (1995) *Going Virtual*, New York, Prentice Hall P T R.
- GRIMSHAW D. J. AND KWOK F.T.SANDY. (1998) The Business Benefits of the Virtual Organization. IN MARGARET, I. M. A. T. (Ed.) *The Virtual Workplace*. IDEA Group Publishing.
- GRINT K. AND WOOLGAR S. (1997) *The Machine at Work: technology, work and organization*, Cambridge, Polity Press.
- GULATI R. (1995) Social structure and alliance fromation patterns: a longitudinal analysis. *Administrative Science Quarterly*, 40, 619-652.
- GUMMESSON, E. (2000) *Qualitative Methods in Management Research* Sage Publications; Thousand Oaks.
- HACKING I. (1999) *The social construction of what*, Cambridge MA: Harvard University Press.
- HACKMAN J.R. AND WALTON R.E. (1986) Leading Groups in Organizations. IN ASSOCIATES, P. S. G. A. (Ed.) *Designing Effective Work Groups*. Sam Framcoscp, Jossey-Bass.
- HACKMAN J.R. AND WALTON R.E. (1990) *Groups that work (and those that don't)*, San Francisco, Jossey-Bass.
- HAGEL J AND SACCONAGHI A. (1996) Who will benefit from virtual information? *McKinsey Quarterly*, n3.
- HAKANSSON H. AND JOHANSON J. (1993) *The Network as governance structure: interfirm cooperation beyond markets and hierarchies*, London, Routledge.
- HAKKEN DAVID (2003) *The Knowledge Landscapes of Cayberspace*, Routledge.
- HALAL W. (1993) The Transition from Hierarchy to .... What? IN HALAL W., G. A., POURDEHNAD J., (Ed.) *Internal Markets: Bringing the Power of Free Enterprise Inside Your Organization*. New York, Wiely.
- HALE R. AND WHITLAM P. (1997) *Towards the Virtual Organization*, London, McGraw-Hill.
- HALL E.T. (1976) *Beyond Culture*, Doubleday New York.
- HALL E.T. AND HALL R.M. (1987) *Hidden Dimensions*, New York, Anchor.
- HAMEL G. (1991) Competition for competence and inter-partner learning within international strategic alliances. *Strategic Management Journal*, 12, 83-103.
- HAMMERSLEY M. AND ATKINSON P. (1995) *Ethnography: principles in practice*, London and New York, Routledge.
- HANDY C. (1990) *The Age of Unreason*, London, Arrow Books.
- HANDY C. (1990) *Inside Organizations*, BBC Enterprises Ltd.
- HANDY C. (1995) Trust and the Virtual Organization. *Harvard Business Review*, May-June, 40-50.
- HANEY V.W. (1973) *Communicaiton and organizational behavior*, Richard D. Irwin Inc.
- HANF K.I. AND O'TOOLE JR. L.J. (1992) Revisting old friends: networks, implemtnation strucures and managment of interorgnizational relations. *European Journal of Political Research*, Vol 21, 163-180.
- HANKMAN J.R. (Ed.) (1990) *Groups that work and those that don't*, San Franciso, Jossey-Bass.
- HANSEN, M. T. (2002) Knowledge Networks: Explaining Effective Knowledge Sharing in Multiuit Companies. *Organizational Science*, 13, 232-248.
- HARDISON O.B. (1990) *Disappearing through the Skylight: Culture and Technology in the*

*Twentieth Century.*, New York:, Penguin.

HARDWICK M. AND BOLTON R. (1997) The Industrial Virtual Enterprise. *Communications of the ACM*, Vol 40, 59-61.

HARMON B. AND ARDISHVILI A. AND CARDOZO R. AND ELDER T. AND LEUTHOLD J. AND PARSHALL J. AND RAGHIAN M. AND SMITH D. (1997) Mapping the University technology transfer process. *Journal of Business Venturing*, Vol 12, 423-434.

HARRIS, R. G. (2001) The knowledge-based economy: intellectual origins and new economic perspectives. *International Journal of Management Reviews*, Vol. 3.

HARRISON I. M. (1994) *Diagnosing Organizations, Methods, Models, and Processes*, Sage Publications.

HASTINGS C. (1996) *The New Organization. Growing the Culture of Organizational Networking*, London, McGraw-Hill.

HATAKENAKA, S. (2005) Development of third stream activity: lessons from international experience HEFCE , UK.

HATCH (1997) see virtual working: learning issues

HAYEK, F. (1945) The Use of Knowledge in Society. *American Economic Review*, Vol 35, 519-30.

HEALEY N.J. AND RAWLINSON M.B. (1993) Interviewing Business Owners and Managers: A Review of Methods and Techniques. *Geoforum*, Vol 24, P339-355.

HECKSCHER C. (1994) Defining the Post-Bureaucratic Type. IN HECKSCHER C., D. A. (Ed.) *The Post-Bureaucratic Organization: New Perspectives on Organizational Change*. Thousand Oaks, CA: Sage.

HEDBERG B. AND DAHLGREN G. AND HANSSON J AND OLVE N. (1994) *Virtual Organizations and Beyond: Discover Imaginary Systems*, John Wiley & Sons.

HEDBERG B. HOLMQVIST M. (1997) Inside the Virtual Organization, Managing Imaginary System. "Managing in an Interconnected World", *Strategic Management Society, 17th Annual International Conference*. Barcelona, Oct 5-8 .

HEDBERG B. HOLMQVIST M. (1998) Learning in Imaginary Organizations: Creating and Sharing Knowledge in Virtual Organizations. *Draft Paper*, Downloaded from website.

HEDLUND G. (1994) A model of knowledge management and the N-form corporation. *Strategic Management Journal*, 15, 73-90.

HEMLIN, S. & RASMUSSEN, S. R. B. (2006) The Shift in Academic Quality Control. *Science, Technology & Human Values*, 31, 173-198.

HEMP, P. & STEWART, T. A. (2004) Leading Change When Business Is Good. (Cover story). *Harvard Business Review*, 82, 60-70.

HENDERSON, D. & THOMAS, M. (1999) Learning Through Strategy-Making IN KEVIN MORGAN AND CLAIRE NAUWELAERS (EDS) (Ed.) *Regional Innovation Strategies: The Challenge for Less-Favoured Regions*. Routledge Taylor & Francis Group.

HENREKSON, M. & ROSENBERG, N. (2001) Designing efficient institutions for science-based entrepreneurship: lessons from US and Sweden *Journal of Technology Transfer* Vol 26, 207-231.

HENRY, N. & ANGUS, T. (1998) Innovation, Networks and Learning Regions? *Service Industries Journal*, 18, 180-182.

HEPWORTH M. AND PICKAVANCE L. AND ZIEMANN B. (2004) The Knowledge Economy in Rural England. *Report to DTI*. The Local Future Groups.

HEPWORTH M. AND SPENCER G. (2004) A Regional Perspective on the Knowledge Economy in Great Britain-Report for the Department of Trade and Industry. London, The Local Futures Group (supported by DTI).

HILL S. AND HARRIS M. AND MARTIN R. (1997) Flexible Technologies, Markets and the Firm: Strategic Choices and FMS. IN MCLOUGHLIN I.P. AND HARRIS M. (Ed.) *Innovation, Organizational Change and Technology*. London, International Thompson Business Press.

HILL S. AND MORGAN B. (1998) Inward Investment, Business Finance and Regional Dev.

HILTZ S.R. AND WELLMAN B. (1997) Asynchronous learning networks as a virtual classroom. *Communications of the ACM*, Vol 40, 44-49.

- HIRSCHHEIM R.A. (1985) *Office Automation*, Chichester, Wiley.
- HIRSCHMAN, A. (1958) *The Strategy for Economic Development* Yale, New Heaven Press.
- HITE J.M. AND WILLIAMS E. J. AND BAUGH S.C. (2005) Multiple networks of public school administrators: an analysis of network content and structure. *Leadership in Education*, April - June Vol 8, 91-122.
- HJERN B. AND PORTER D. (1981) Implementation Structures: A New Unit of Administrative Analysis. *Organization Studies*, Vol 2, 211-227.
- HOEFLING T; (2001) *Working Virtually: Managing People for Successful Virtual Teams and Organizations*. Stylus, Sterling.
- HOEGL, M., PARBOTEEAH, K. P. & MUNSON, C. L. (2003) Team-Level Antecedents of Individuals' Knowledge Networks. *Decision Sciences*, 34, 741-770.
- HOFSTEDE G. (1994) *Uncommon Sense About Organizations*, Thousand Oaks, London, New Delhi, Sage Publications.
- HOLDEN N. (2002) *Cross-cultural management : a knowledge management perspective*, Harlow, Financial Times Prentice Hall.
- HOLLAND C. (1998) The Importance of Trust and Business Relationships in the Formation of Virtual Organizations. IN P. SIEBER AND J. GRIESE (Ed.) *Organizational Virtualness, Proceedings of the VoNet - Workshop, April 27-28, Institute of Information Systems, Dept. of Information Management, University of Bern*, pp. 53-64.
- HOLLIDAY, A. (2002) *Doing and Writing Qualitative Research*, London, Sage publications.
- HORTON R.B. (1992) Surprise governance. *Directors & Boards*, 16, 9-11.
- HORTON S. AND FARNHAM D. (1999) *Public Management in Britain*, Macmillan Press Ltd.
- HOWELL. (1996) Tacit Knowledge, Innovation and Technology Transfer. *Technology Analysis and Strategic Management*, Vol 8, pp 91-106.
- HUBER G.P. (1991) Organizational learning: the contributing process and the literatures. *Organization Science*, 2, 88-115.
- HUDSON, R. (2002) The Role of Foreign Inward Investment. IN L. EVANS, P. J. B. T. E. (Ed.) *The Northern Regional Economy: progress and prospects in the North of England* London: Mansell
- HUGHES J. AND TOLMIE P AND ROUNCEFIELD M AND SHARROCK W. (1998) Managing relationships: where the 'virtual' meets the 'real'. *Department of Sociology, Lancaster University*, <http://www.comp.lancs.ac.uk/sociology/papers/Tolmie-el-al-Managing-Relationships.pdf>.
- HUGHES J. O'BRIEN, J.-R., DAVE - ROUNCEFIELD, MARK - TOLMIE, PETER., (2001) Some real problems of virtual organization. *New Technology, Work and Employment*, 16:1.
- HUNTER G; (1999) Some "Do's" of knowledge Management. Ottawa, Health Canada.
- HUXHAM, C. (1996) *Creating Collaborative Advantage*, London:, Sage.
- HUXHAM C. AND HIBBERT P. (2004) Collaborating to Know? : Interorganizational Engagement and Learning. *Advanced Institute of Management Working Paper Series*, 013-December.
- HUXHAM C. AND VANGEN V. (2004) Doing things collaboratively: Realizing the advantage or succumbing to inertia? *Organizational Dynamics*, 33, 190-201.
- IGBARIA M. AND TAN MARGARET (1998) *The Virtual Workplace*, IDEA Group Publishing.
- INKPEN A.C. (1996) Creating knowledge through collaboration. *California Management Review*, Vol 39, 123-40.
- INNES J.E. AND BOOHER E.E. (1999) Consensus building and complex adaptive systems: a framework for evaluating collaborative planning:. *Journal of Administrative Planning*, Vol 65, 412-423.
- JACKSO TERENCE. (1995) *Cross-cultural management*, Oxford [England], Butterworth-Heinemann.
- JACKSON P.J. (1999) Introduction: from new designs to new dynamics. IN JACKSON P.J. (Ed.) *Virtual working: social and organizational dynamics*. London and New York, Routledge.

- JACKSON P.J. (1999) *Virtual Working: social and organizational dynamics*, London, Routledge.
- JACKSON P.J. AND QUINN, J. J. (1996) Control in the Virtual Organization. *Paper presented to the Management Control Association*. Sheffield, 24 May 1996.
- JACKSON P.J. AND VENDER WEILEN J. (1998) *Teleworking: International Perspectives: from Telecommuting to the virtual organization*, London, Routledge.
- JACOB D. (1996) *The Knowledge Offensive*, Alphen aan den Rijn, Samson.
- JACOB, M. (2000) Imagining the future university. IN JACOB, M., HELLSTROM, T. (EDS), (Ed.) *The Future of Knowledge Production in the Academy* Buckingham Open University Press
- JACOB M. AND LUNDQVIST M. AND HELLSMARK H. (2003) Entrepreneurial transformations in the Swedish University System: the case of Chalmers University of Technology. *Research Policy*, 32, 1555-1568.
- JACOBS, D. (1998) Innovation policies within the framework of internationalization. *Research Policy*, 27, 711-724.
- JAIN A.K AND APARICIO M.I. AND SINGH M.P. (1999) Agents for process coherence in virtual enterprises. *Communications of the ACM*, Vol 42, 62-68.
- JARILLO J.C. (1988) On strategic networks. *Strategic Management Journal*, 9.
- JARVENPAA, S. L. & TANRIVERDI, H. (2003) Leading Virtual Knowledge Networks. *Organizational Dynamics*, 31, 403-412.
- JARVENPAA SL AND LEIDNER D.E. (1999) Communication and trust in global virtual teams. *Organization science*, Nov-Dec, Vol.10, No.6., pp.791-818.
- JAVENPAA S.L AND KNOLL K. AND LEIDNER D.E. (1998) Is Anybody Out There? Antecedents of Trust in Global Virtual Teams;. *Journal of Management Information Systems*;, Spring, n4, pp 29-64.
- JICK T. D. (1979) Mixing qualitative and quantitative methods: triangulation in action. *Administrative Science Quarterly*, 24, 602-11.
- JOHANSSON, B. (1991) Economic Networks and self-organization. IN BERGMAN, E., MAIER, G. & TODTLING F (ED). (Eds.) *Regions Reconsidered: Economic Networks, Innovation and Local Development in Industrialized Countries*. London: Mansell.
- JOHNSON, B. & GREGERSEN, B. (1996) The Institutional set-up of national Systems of Innovation and Economic Integration *Journal of Industry Studies* 3.
- JOHNSON, L. D., NEAVE, E. H. & PAZDERKA, B. (2002) Knowledge, innovation and share value. *International Journal of Management Reviews*, Vol. 4 Issue 2, p101, 34p.
- JONES C., H., W.S. AND BORGATTI, S.P., (1997) A general theory of network governance: exchange conditions and social mechanisms. *Academy of Management Review*, 22, 911-945.
- JUMA, C., FANG, K., HONCA, D., HUETE-PEREZ, J., KONDE, V. & LEE, S. H. (2001) Global governance of technology: meeting the needs of developing countries [1]. *International Journal of Technology Management*, 629.
- JUN KOO (2005) Knowledge-based industry clusters: Evidenced by geographical patterns of patents in manufacturing. *Urban Studies*, 42, 1487-1505.
- KAFKALAS, G. & KOMNINOS, N. (1999) The Innovation-Region Strategy: Lessons from the central Macedonia regional Technology Plan IN KEVIN MORGAN AND CLAIRE NAUWELAERS (EDS) (Ed.) *Regional Innovation Strategies: The Challenge for Less-Favoured Regions*. Routledge Taylor & Francis Group.
- KAGAN, R. A. (1991) Adversarial Legalism and American Government *Journal of Policy Analysis and Management*., Vol 10:, 369-406.
- KANTER R.M. (1989) *When Giants Learn to Dance*, London, Simon and Schuster.
- KANTER R.M. (1991) The Future of Bureaucracy and Hierarchy in Organization Theory. IN BOURDIEU, P. A. C., J. (Ed.) *Social Theory for a Changing Society*. Boulder, Colorado Westview.
- KANTER R.M., E. R. G. (1992) Conclusion: making network research relevant to practice. IN NOHRIA, N., ECCLES, R.G., (Ed.) *Network Organizations: structure , form and action*. Cambridge, MA: Harvard Business School Press.

- KARLSSON, C. (1994) From Knowledge and technology networks to network technology. IN JOHANNSON, B., KARLSSON, C. & WESTIN L (ED.). (Eds.) *Patterns of a Network Economy*. Berlin: Springer-Verlag.
- KARLSSON, C., FLENSBURG, P. & HORTE, S.-A. (2005) Knowledge Spillovers and Knowledge Management. *KM Review*, 8, 32-32.
- KASPER-FUEHRER E.C AND ASHKANASY N. M. (2003) The Interorganizational Virtual Organization. *International Journal of Management and Organizations*, Vol 33, 36-64.
- KAYE M. AND SEIFER D.M. (1996) It is a different world there: planning for expatriate success through selection, pre-departure training and on-site socialization. *Human Resource Planning*, 19, 32.
- KEEBLE, D., LAWSON, C. & LAWTON-SMITH, H. (1998) International Processes, Networking and local embeddedness in technology-intensive small firms. *Small Business Economics*, 11.
- KEEBLE, D. & WILKINSON, F. (1999) Collective learning and knowledge development in the evolution of regional clusters of high technology SMEs in Europe *Regiona Studies* 33.
- KEEBLE, L. & LOADER, B. (2001) *Community informatics : shaping computer-mediated social relations*, London, Routledge.
- KICKERT J.M. WATER. AND KLIJN ERIK-HANS (1997) *Managing Complex Networks: Strategies for the Public Sector*, Sage Publication Ltd.
- KIEL, L. D. (1994.) *Managing Chaos and Complexity in Government: A New Paradigm for Managing Change, Innovation, and Organizational Renewal.* , San Francisco: , Jossey-Bass, .
- KIMBERLY J.R., R. L. R., SCHWARTZ J. S., HILLMAN A. L., PAUL M.V. AND TEPLENSKY J.D., (1990) Innovation and Creativity at Work. IN WEST M.A. AND FARR J.L. (Ed.), John Wiley and Sons.
- KLIJN E.-H. AND TEISMAN G.R. (1997) Strategies and Games in Networks. IN KICKERT J.M. WATER. AND KLIJN ERIK-HANS (Ed.) *Managing Complex Networks: Strategies for the Public Sector*. Sage Publication Ltd.
- KLIJN, E.-H. (1996) Analyzing and managing policy processes in complex networks: A theoretical examination of the. *Administration & Society*, 28, 90.
- KLIJN, E.-H. (2001) Rules as Institutional Context for Decision Making in Networks. *Administration & Society*, 33, 133.
- KLIJN, E.-H. (2002) Governing Networks in the Hollow State: Contracting out, process management or a combination of the two? *Public Management Review*, 4, 149-165.
- KLIJN, E. H., KLIJN, E.-H., KOPPENJAN, J. F. M. & KOPPENJAN, J. F. M. (2000) PUBLIC MANAGEMENT AND POLICY NETWORKS: Foundations of a network approach to governance. *Public Management (UK)*, Vol. 2 Issue 2.
- KLIJN, E.-H. & TEISMAN, G. R. (2003) Institutional and Strategic Barriers to Public-Private Partnership: An Analysis of Dutch Cases. *Public Money & Management*, 23, 137-146.
- KNIGHTS D AND NOBLE F. AND VURDUBAKIS T. AND WILLMOTT H. (2001) Chasing Shadows: Control, Virtuality and the Production of Trust\*. *Organization Studies*, Vol 2, 311-316.
- KOCHEN M. AND DEUTSCH K.W. (1980) *Decentralization: sketches towards a rational theory*, Cambridge Mass, Oelgeschlager Gunn and Hain.
- KOMNINOS, N. (2004) Regional intelligence: distributed localized information systems for innovation and development. *International Journal of Technology Management*, 28, 483-506.
- KONDE, V. (2004) Internet development in Zambia: a triple helix of government-university-partners. *International Journal of Technology Management*, 27, 440-451.
- KONSTADT P. (1990) Into the Breath. *CIO*, 11, 71-73.
- KOSTELANETZ R. (1968) *Beyond Left and Right: Radical Thought For Our Time*, William Morrow & Co.
- KOTTER J. (1990) *A Force for Change*, New York, Free Press.
- KOTTER, J. P. Leading Change: Why Transformation Efforts Fail. (Cover story). *Harvard Business Review*, 73, 59.
- KOTTER, J. P. & SCHLESINGER, L. A. Choosing strategies for change. *Harvard Business*



*Review*, 57, 106-114.

- KRAMER, R. M. & TYLER, T. R. (1996) *Trust in organizations : frontiers of theory and research*, Thousand Oaks, Calif., Sage Publications.
- KRAUSS R. AND FUSSELL S. (1990) Mutual Knowledge and Communicative Effectiveness. IN GALEGHER J., A. K. R. E. A. E. C. (Ed.) *Intellectual Teamwork: the social and technological bases of cooperative work*. Hillsdale, NJ: Erlaum.
- KRAUT R. AND STEINFELD C. AND CHAN A. AND BULTER B. AND HOAG A. (1998) Coordination and virtualization: the role of electronic networks and personal relationships. *Journal of Computer mediated communication*, Vol 3.
- KRUGLANSKI, A. (1989) *Lay Epistemic and Human Knowledge*, New York, Plenum.
- LAM A. (2004) Organizational Innovation. IN FAGERBERG J. AND MOWERY D. AND NELSON R. (Ed.) *Handbook of Innovation*. Oxford University Press.
- LAM A. (2004) Work Roles and Careers of R&D Scientists in Network Organizations. *DRUID Summer Conference on Industrial Dynamics, Innovation and Development, June 14-16, 2004*. Copenhagen, Denmark.
- LAMBOOY, J. G. (2004) The transmission of knowledge, emerging networks, and the role of universities: an evolutionary approach. *European Planning Studies*, 12, 643-657.
- LANDABASO, M. & REID, A. (1999) Developing Regional Innovation Strategies: The European Commission as Animator. IN KEVIN MORGAN AND CLAIRE NAUWELAERS (EDS) (Ed.) *Regional Innovation Strategies: The Challenge for Less-Favoured Regions*. Routledge Taylor & Francis Group.
- LANE CHRISTEL AND BACHMANN REINHARD (1998) *Trust within and between organizations : conceptual issues and empirical applications*, New York, Oxford University Press.
- LANE R. (1966) The decline of politics and ideology in a knowledgeable society. *American Sociological Review*, October.
- LASH S. AND URRY J. (1987) *The End of Organized Capitalism*, Oxford, Oxford University Press.
- LAZZERETTI, L., TAVOLETTI, E. & NBSP (2005) Higher Education Excellence and Local Economic Development: The Case of the Entrepreneurial University of Twente. *European Planning Studies*, 13, 475-493.
- LEAT P. D. AND SELTZER K. AND STOKER G. (2002) *Towards Holistic Governance: The New Reform Agenda*, Palgrave.
- LEE A. (1989) A Scientific Methodology for MIS Case Studies. *MIS Quarterly*, Vol 13, NO 1. 32-50.
- LESEURE, M., BIRDI, K., BAUER, J., DENYER, D. & NEELY, A. D. (2004) Adoption of Promising Practice: a systematic review of the literature:. *Advanced Institute of Management Research*, Februar.
- LEVITT B., M. J. G. (1988) Organizational learning. *Annual Review of Sociology*, 14, 319-340.
- LEWIS DAVID AND WALLACE HELEN. (1984) *Policies into Practice*, London, Heinemann Educational Books.
- LEWIS, E. (1980) *Public Entrepreneurship: Toward a Theory of Bureaucratic Political Power*. , Bloomington: Indiana University Press.
- LEYDESDORFF, L. H. W. L. N., DOLFSMA, W. & VAN DER PANNE, G. (2006) Measuring the knowledge base of an economy in terms of triple-helix relations among technology, organization, and territory *Research Policy*, 35, 181-199.
- LI F AND BARLOW A. (2000) Barriers to Virtual Teams: Information System - Research, Teaching and Practice. *Proceeding of the 5th UKAIS Conference; University of Wales Institute, Cardiff; 26th -28th April*.
- LI, R. (2004) *Technology and Knowledge Transfer in China* Ashgate
- LIEBESKIND J.P. AND OLIVER A.L. AND ZUCKER L. AND BREWER M. (1996) Social networks, Learning and flexibility: sourcing scientific knowledge in new biotechnology firms. *Organization Science*, 7, 428-443.
- LIKANEN, E. (2003) A more innovative, entrepreneurial Europe. *Opening address at the XI*

*Congress of Eurochambres*. Rome, 9 October 2003.

LIM, K. (2000) The many faces of absorptive capacity: spillovers of copper interconnect technology for semiconductor chips. *Mimeo, MIT*.

LINCOLN J.R. (1982) Intra-and inter-) organizational networks. IN SAMUEL B. BACHARACH (ED). (Ed.) *Research in the Sociology of Organizations*. Greenwich, CT: JAI Press.

LIPNACK J. AND STAMPS J. (1994) *The Age of Networks*, New York, John Wiley and Sons.

LIPNACK J. AND STAMPS J. (1997) *Virtual Teams: reaching across space, time and organizations with technology*, New York, John Wiley & Sons.

LITTLE A.D. (2001) North West Science and Darebury Development Study: Report to the Government Office for the North West.

LOCKETT, M. Culture and the Problems of Chinese Management. *Organization Studies (Walter de Gruyter GmbH & Co. KG)*, 9, 475-496.

LOEBBECKE C. AND JELASSI T. (1997) Concepts and technologies for virtual organizing: The Gering journey. *European Management Journal*, Vol 15, 138-146.

LOVERING, J. (1999) Theory led by policy: the inadequacies of the new regionalism. *International Journal of Urban and Regional Research*, 23, 379-395.

LUFT J. (1984) *Group processes : an introduction to group dynamics*, Palo Alto, Calif. : Mayfield Pub. Co., c.

LUNDAVALL, B. A. (1988) Innovation as an interactive process: from user-producer interaction to the national system of innovation IN (ED), G. D. (Ed.) *Technical Change and Economic Theory* London Pinter

LUNDAVALL B-A. AND JOHNSON B. (1994) The Learning Economy. *Journal of Industry Studies*, 1, pp 23-42.

LYNN L.E. (1981) *Managing the Public's Business: The Job of the Government Executive*, New York, Basic Books.

MACARTHUR, M. (2000) The Triple Helix (Book review). *Library Journal*, 125, 126.

MACHLUP, F. (1962) *The Production and Distribution of Knowledge in the United States*, Princeton University Press.

MAHONEY J.T. (2002) Book Review: Building the Virtual State: Information Technology and Institutional Change. *Academy of Management Review*, Vol 27, pp 619-630.

MAILLAT, D., CREVOISLIER, O. & LECOQ, B. (1994) Innovation Networks and territorial dynamics: a tentative typology. IN JOHANSSON, B., KARLSSON, C. & WESTIN L (ED.). (Eds.) *Patterns of a Network Economy*. Berlin: Springer-Verlag.

MALERBA F. (2002) Sectoral systems of innovation and production. *Research Policy*.

MALMBERG, A. & MASKELL, P. (1997) Towards an explanation of regional specialization and industry agglomeration. *European Planning Studies*, 5, 25.

MANDELL M.P. (1990) Network Management: Strategic Behavior in the Public Sector. IN (ED.), R. W. G. A. M. P. M. (Ed.) *Strategies for Managing Intergovernmental Policies and Networks*. New York, Praeger.

MANNERS G. AND KEEBLE D. AND RODGERS B. AND WARREN K. (1980) *Regional Development in Britain*, Chichester, New York, Brisbane, Toronto, John Wiley & Sons.

MARCH J.G. AND SPROULL L.S. (1990) Technology, Management, and Competitive Advantage. IN GOODMAN P.S., S. L. S. (Ed.) *Technology and Organizations*. Oxford, San Francisco, Jossey-Bass Publishers.

MARIN B. (1990) Generalized political exchange: preliminary considerations. IN B(ED.), M. (Ed.) *Generalized political exchange: antagonistic cooperation and integrated policy circuits*. Frankfurt, Campus Verlag.

MARQUES, J. P. C., CARAÃÇA, J. M. G. & DIZ, H. (2006) How can university“industry“government interactions change the innovation scenario in Portugal?“the case of the University of Coimbra. *Technovation*, 26, 534-542.

MARSHALL J. (1981) Making Sense as a personal process. IN REASON P. AND ROWAN J. (EDS) (Ed.) *Human Inquiry: A Sourcebook of New Paradigm Research*. Chichester, Wiley.

MARSHALL J. AND RICHARDSON R. AND HOPKIN J. (1999) The Employment Implications of Civil Service Reform in the United Kingdom: National and Regional

- Evidence from the North East of England. *Environment and Planning*, 31, 803-807.
- MARTIN, R. & SUNLEY, P. (2003) Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography*, Vol 3, pp 5-35.
- MARTINEZ, A. C. Transformation. *Harvard Business Review*, 73, 166-166.
- MASKELL, P. (2001) Knowledge Creation and Diffusion in Geographic Clusters. *International Journal of Innovation Management*, 5, 213.
- MASKELL P. (1998) *Competitiveness, localized learning and regional development: specialization and property in small open economies*, London: Routledge.
- MASKELL P. AND MALMBERG A. (1999) Localized learning and industrial competitiveness. *Cambridge Journal of Economics*, 23, 167-185.
- MASSEY, D., QUINTAS, P. & WIELD, D. (1992) *Hi-technology fantasies*, London, Routledge.
- MCCUTCHEON, D. M. & MEREDITH, J. R. (1993) Conducting Case Study research in operations management *Journal of Operations Management*, Sep Vol 11, 239-265.
- MCDERMOTT R. (???) From craftwork t learning systems: transforming knowledge work., *working draft*.
- MCLAGAN, P. A. N., C (1995) *The Age of Participation: New Governance for the Workplace and the World*. San Francisco: Barrett-Koehler,.
- MCLOUGHLIN I. P. (1999) *Creative Technological Change: The Shaping of Technology and Organizations*, Routledge.
- MCLOUGHLIN I. P. AND JACKSON P. (1999) Organizational learning and virtual organization. IN JACKSON P.J. (Ed.) *Virtual working: social and organizational dynamics*. London and New York, Routledge.
- MEAD R; (1998) *International management : cross-cultural dimensions*, Malden, Mass., Blackwell Business.
- MECHSTROTH D.J. (1994) Reengineering US manufacturing: implicaitons of structural changes in the US economy. *Business Economics*, 29, 43-39.
- MELTSNER A. ; BELLAVITA C; (1983) *The Policy Organization*, Beverly Hills CA: Sage.
- METCALFE, J. S., JAMES, A. & MINA, A. (2005) Emergent innovation systems and the delivery of clinical services: The case of intra-ocular lenses. *Research Policy*, 34, 1283-1304.
- MEYER, M. (2003) Academic entrepreneurs or entrepreneurial academics? researchâ€based ventures and public support mechanisms. *R & D Management*, 33, 107.
- MEYER-KRAHMER, F. & SCHMOCH, U. (1998) Science-based technologies: university-industry interactions in four fields. *Research Policy*, 27, 835-851.
- MILES R.E. AND SNOW C.C. (1986) Network Organizations: New concepts for new forms. *California Management Review*, 28, 62-73.
- MILES R.E. AND SNOW C.C. (1993) Internal markets and network organizations. IN HALAL W.E. AND GERANMAYEH A. AND PARDEHNAD J. (Ed.) *Internal Markets: Bringing the power of free enterprise inside your organization*. New York, John Wiley.
- MILES R.E. AND SNOW C.C. (1994) *Fit, Failure and the Hall of Fame*, New York, Free Press.
- MILES R.E. AND SNOW C.C. (1995) The new network firm: a spherical structure built on a human investment philosophy. *Organizational Dynamics*, 23, 4-15.
- MILLER, G. & DINGWALL, R. (1997) *Context and Methods in Qualitative Research* Sage
- MINTZBERG H. (1979) An emerging strategy of direct research. *Administrative Science Quarterly*, 24, 582-589.
- MIYATA Y; (2000) An empirical analysis of innovative activity of universities in the United States. *Technovation* 20 (2000) 413-425.
- MOHRMAN A.S. (1999) The contexts for Geographically Dispersed Teams and Networks. IN COOPER C.L. AND ROUSSEAU D.M. (Ed.) *Trends in Organizational Behaviour*. John Wiley & Sons Ltd.
- MOLINA-MORALES, F. X., LOPEZ-NAVARRO, M. A. & GUIA-JULVE, J. (2002) The Role of Local Institutions as Intermediary Agents in the Industrial District. *European Urban and Regional Studies*, 9, 315-329.
- MOLINA-MORALES, F. X., LOPEZ-NAVARRO, M. A. & GUIA-JULVE, J. (2002) The

- Role of Local Institutions as intermediary agents in the industrial district *European Urban and Regional Studies* 9, 315-329.
- MORGAN B. AND BROOKSBANK D. AND CONNOLLY M. (2000) The role of networking in the new political economy of regional development. *European Planning Studies*, Vol 8.
- MORGAN G. (1983) *Beyond Method*, Sage Publication.
- MOWSHOWITZ A; (1997) On the Theory of Virtual Organization. *SYST. RES. BEHAV. SCI. VOL. 14*, 373-384.
- MOWSHOWITZ A. (1994) Virtual Organization: A vision of Management in the Information Age. *The Information Society*, 10, 267-288.
- MOWSHOWITZ A. (2002) *Virtual Organization: toward a theory of societal transformation stimulated by information technology*, Quorum Books.
- MYERS M.D. AND AVISON D. E.; (2002) An Introduction to Qualitative Research in Information Systems;. *Qualitative Research in Information Systems: A Reader*, Sage Publications; London pp 3-12.
- MYERS, S. & MARQUIS, D. G. (1969) *Successful Industrial Innovation*, Washington, D.C., National Science Foundation.
- NACHMIAS D. AND NACHMIAS C. (1976) *Research Methods in the Social Sciences*, New York, St Martin's.
- NAHAPIET J. AND GHOSHAL S. (1998) Social capital, intellectual capital and the organizational advantage:. *Academy of Management Review*, 22, 242-266.
- NAKAMURA M. (2002) *Alliance, Cooperative Ventures and The Role of Government in the Knowledge Based Economy*, The Centre of Japanese Research, The University of British Columbia.
- NAKAMURA M; NELSON H; VERTINSKY I; (2002) Cooperative R&D and the Canadian Forest Products Industry. IN NAMAMURA, M. (Ed.) *Alliance, Cooperative Ventures and The Role of Government in the Knowledge Based Economy*. The Centre of Japanese Research, The University of British Columbia.
- NAUWELAERS, C. (1999) Creating a Regional Innovation Policy in Lorraine. IN KEVIN MORGAN AND CLAIRE NAUWELAERS (EDS) (Ed.) *Regional Innovation Strategies: The Challenge for Less-Favoured Regions*. Routledge Taylor & Francis Group.
- NEEF D. AND SIESFELD A. AND CEFOLA J. (1998) *The Economic Impact of Knowledge*, Butterworth Heinemann.
- NEUMAN W.L. (2000) *Social Research Methods: qualitative and quantitative approaches*, Boston: Allyn and Bacon.
- NIGHTINGALE, P. (1998) A cognitive model of innovation. *Research Policy*, 27, 689-709.
- NIJKAMP, P., VAN OIRSCOHT, G. & OOSTERMAN, A. (1994) Knowledge networks, science parks and regional development: An international comparative analysis of critical success factors. IN J.R.CUADRADO-ROURA, P.NIJKAMP & (EDS), P. S. (Eds.) *Moving Frontiers: Economic Restructuring, Regional Development and Emerging Networks*. Aldershot: Avebury.
- NOBLE B.P. (1996) *Book Review: The Boundaryless Organization: Breaking the Chains of Organizational Structure. Strategy and Business*, [Online], Second Quarter, Available: <http://www.strategy-business.com/books/96296>.
- NOHRIA N. (1992) Introduction: is a network perspective a useful way of studying organizations. IN NOHRIA, N., ECCLES, R.G., (Ed.) *Network Organizations*. Cambridge, MA: Harvard Business School Press.
- NOHRIA N. AND ECCLES R.G. (1992) Face to face: making network organizations work. IN NOHRIA, N., ECCLES, R.G., (Ed.) *Network Organizations*. Cambridge, MA: Harvard Business School Press.
- NONAKA IKUJIR O (1994) A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, 5.
- NONAKA, K. (1991) The Knowledge-Creating Company. *Harvard Business Review*, November -December, 96-104.
- NOOTEBOOM, B. (1999) Innovation and inter-firm linkages: new implications for policy.

- Research Policy*, 28, 793-805.
- NORTON B. AND SMITH C. (1996) *Understanding the virtual organisation in a week*, London, Headway : Hodder & Stoughton.
- OATES D. (1998) *Outsourcing and the virtual organization : the incredible shrinking company*, London, Century Business.
- OECD (1992b) *Technology and the Economy: The Key Relationships*, Paris, OECD.
- OECD (1994) *National Systems of Innovation: General Conceptual Framework*, Paris, OECD;
- (2000) *Innovation and Economic Performance. DSTI/STP*, OECD, Paris.
- OECD; (2001) *Knowledge Management in the Public and Private Sectors: Similarities and Differences in the Challenges Created by the Knowledge Intensive Economy*. Centre for Education Research and Innovation, Organization for Economic Cooperation and Development, Paris.
- OINAS, P. & MALECKI, E. J. (2002) The evolution of technologies in time and space: from national and regional to spatial innovation systems. *International Science Review*, 25, 132-148.
- OKKONEN J. (???) Organizing Knowledge Work Virtually. *The labor Market and Job Environment*.
- ONE (ONE NORTH EAST). (2002) *Realizing Our Potential - The Regional Economic Strategy for the North East of England*.
- ONE (ONE NORTH EAST); (1999) *Regional Economic Strategy for the North East. Newcastle upon Tyne; ONE*.
- ONE (ONE NORTH EAST); (2001) *Realizing the Potential Of the North East's Research Base - Consultation document. One North East, The Development of Agency for the North East of England*.
- ONE NORTH EAST (1999) *Regional Economic Strategy for the North East ONE*, Newcastle upon Tyne
- ONE NORTH EAST (2001) *Innovation: Strategy & Action Plan 2001- Building Knowledge Driven Region ONE*, Newcastle upon Tyne
- ONE NORTH EAST. (2001) *Realizing the Potential Strength of North East's Research Base: Draft Document. www.onenortheast.co.uk*.
- ORLIKOWSKI, W. J. & BAROUDI, J. J. (1991) Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information System Research* Vol 2, 1-28.
- ORMEROD P; (1998) *Butterfly Economics*, Faber and Faber; London.
- OSLAND G.E. (1990) Doing business in China: a framework for cross-cultural understanding. *Marketing Intelligence and Planning*, 8, 4-14.
- OSTROM E. (1990) *Governing the Commons: The Evolution of Institutions of Collective Action*, Cambridge University Press.
- OSWICK C; KEENOY T.W; GRANT D; (2000) Discourse, organizations and organizing: Concepts, objects and subjects. *Human Relations*, 53(9): 1115-1123: 013425.
- OWEN-SMITH, J. & POWELL, W. W. (2003) The expanding role of university patenting in the life sciences: assessing the importance of experience and connectivity. *Research Policy*, 32, 1695-1711.
- PANTELI N. (2004) Discursive articulations of presence in virtual organizing. *Information and Organization*, 14, 58-81.
- PARAYIL, G. & SREEKUMAR, T. T. (2004) Industrial development and the dynamics innovation in Hong Kong. *International Journal of Technology Management*, 27, 369-392.
- PARKS M. R. (2000) Communication Networks and Relationship Life Cycles. IN DINDIA K. AND DUCK S. (Ed.) *Communication and Personal Relationships*. John Wiley & Sons. Ltd.
- PATTON M.Q. (1990) *Qualitative Evaluation and Research Methods*, Newbury Park, CA: Sage.
- PAVITT, K. (1984) sectorial Patterns of Technological Change: towards a taxonomy and a theory *Research Policy*, 13, 343-374.
- PAVITT, K. (1998) The social shaping of the national science base. *Research Policy*, 27, 793-

805.

- PERRONE V. (1997) The co evolution of contexts and structures: the N-form. IN CLARK T. (Ed.) *Organizational Behavior: Essays in Honors of Derek S. Pugh*. Aldershot, Hant: Ashgate.
- PETERSEN, S. (2004) Innovation out of box. *eWeek*, 21, 38-38.
- PETTIGREW A.M. (1988) Longitudinal field research on change: theory and ractice. *Paper presented at the National Science Foundation Conference on Longitudinal Research Methods in Organizations*. Austin.
- ETTIGREW A.M. (1997) What is processual analysis. *Scandinavian Journal of Management*, 13, 337-48.
- PETTIGREW A.M. AND FENTON E.M. (2000) *The Innovating Organization*, London, Sage Publication Ltd.
- PETTIGREW A.M. AND FENTON E.M. (2000a) Complexities and Dualities in Innovative Forms of Organizing. IN PETTIGREW, A. F. (Ed.) *The Innovating Organization*. London, Sage Publication Ltd.
- PETTIGREW A.M. AND FENTON E.M. (2000b) The role of social Mechanisms in an Emerging Network: The case of the Pharmaceutical Network in Coopers & Lybrand Europe. IN PETTIGREW, A. F. (Ed.) *The Innovating Organization*. London, Sage Publication Ltd.
- PETTIGREW A.M. AND FENTON E.M. (2000c) Integrating a Global Professional Services Organization: The Case of Ove Arup Partnership. IN PETTIGREW, A. F. (Ed.) *The Innovating Organization*. London, Sage Publication Ltd.
- PETTIGREW A.M. AND FENTON E.M. (2000d) Theoretical perspectives on new forms of organizing. IN PETTIGREW, A. F. (Ed.) *The Innovating Organization*. London, Sage Publication Ltd.
- PETTIGREW A.M. AND WHIPP R. (1991) *Managing Change for Competitive Success*, Oxford, Blackwell.
- PFEFFER, J. (1992) *Managing With Power*  
Boston: Harvard Business School Press.
- PFEFFER J. (1992) *Managing with Power: politics and influence in organizations*, Boston, Harvard Business School Press.
- PFIFNER J. M. AND SHERWOOD F. P. (1960) *Administrative Organization*, Englewood Cliffs, Prentice-Hall.
- PLEWA, C. & QUESTER, P. (2006) Satisfaction with university-industry relationships: the impact of commitment, trust and championship. *International Journal of Technology Transfer & Commercialization*, 4-4.
- PODOLNY J.M. (1994) Market uncertainty and the social character of economic exchange. *Administrative Science Quarterly*, 39, 458-483.
- PODOLNY J.M. AND PAGE K.L. (1998) Network Forms of Organization. *Annual Review of Sociology*, Vol 24, pp 57-76.
- POLLARD A. (1985) Opportunities and Difficulties of a teacher-ethnographer: a personal account. IN BURGESS R.G. (Ed.) *Field Methods in the Study of Education*. Lewes, Falmer.
- POOLE S. M. (1999) Organizational Challenges for the new forms. IN DESANCTIS, J. F. A. G. (Ed.) *Shaping Organization Form: Communication, Connection and Community*. Sage Publications.
- PORAT M. (1977) The Information Economy: Definition an Measurement. *US Department of Commerce, Office of Telecommunications*.
- PORTER, M. E. (2000) Location, competition, and economic development: local clusters in a global economy. *Economic Development Quarterly*, 14, 15-34.
- POWELL W.W. (1990) Neither market not hierarchy: network forms of organization. IN B. STAW (Ed.) *Research in Organizational Behaviour*. Greenwich, CT: JAI Press.
- POWELL W.W. AND KENNETH W. KOPUT AND LAUREL SMITH-DOERR. (1996) Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology. *Administrative Science Quarterly*, 41, 116 - 145.
- PRAHALD C.K. AND HAMEL G. (1990) The Core competence of the corporation. *Harvard Business Review*, 68, 79-81.

- PRESTON (1998) *Journal of Computer mediated communication & organization science on virtual organization*.
- QUINN, J. B. (1992) *The Intelligent Enterprise*, New York, Basic Books.
- QUINN, J. B., ANDERSON, P. AND FINKELSTEIN, S (1996) Leveraging Intellect *Academy of Management Executive*, 10(3):7-27.
- RANDLESOME, C. & BRIERLEY, W. (1993) *Business cultures in Europe*, Oxford, Butterworth-Heinemann.
- RAPPERT, B., WEBSTER, A. & CHARLES, D. (1999) Making sense of diversity and reluctance: academic-industrial relations and intellectual property. *Research Policy*, 28, 873-890.
- RATCHEVA V. AND BINKS M. (2002) Developing collective knowledge in geographically distributed teams. *International Journal of Networking and Virtual Organizations*, 1.
- REDDY R. (1990) A technological perspective on new forms of organizations. IN GOODMAN P.S., S. L. S. (Ed.) *Technology and Organizations*. Oxford, San Francisco, Jossey-Bass Publishers.
- RHODES R.A.W. (1997 (a)) Forward Message. IN KICKERT J.M. WATER. AND KLIJN ERIK-HANS (ED) (Ed.) *Managing Complex Networks: Strategies for the Public Sector*. Sage Publication.
- RHODES R.A.W. (1997 (b)) *Understanding Governance*, Buckingham, Open University Press.
- RILES A. (2001) *The Network Inside Out*, Ann Arbor: The University of Michigan Press.
- RING P.S. AND VAN DE VEN A.H. (1992) Structuring Cooperative Relationships Between Organizations. *Strategic Management Journal*, 13, 483-98.
- RITTEL, H. W. J. A. W., M.M (1973) Dilemmas in a General Theory of Planning *Policy Sciences*, 4, 155-169.
- ROBBINS, S. P. (1998) *Organizational Behavior: Concepts, Controversies, Applications*. 8th ed., New Jersey:, Prentice Hall, Inc.
- ROBERTS, N. (2000) Coping with Wicked Problems *IPMN* Sydney
- ROBEY D. AND SCHWAIG K.S. AND JIN L. (2003) Intertwining material and virtual work. *Information and Organization*, Vol 13, 119-129.
- ROBSON C. (1993) *Real World Research*, Oxford, Blackwell.
- ROGERS D. L. AND WHETTEN D.A. (1982) *Interorganizational Coordination: Theory, Research, and Implementation*, Iowa State University Press, Ames.
- ROGERS J. AND BOZEMAN B. (2001) Knowledge Value Alliances: An Alternative to the R&D Project Focus Evaluation. *Science , Technology and Human Values*, 26, 23-35.
- ROISIN T. (1999) How do we know the value of higher education to regional development. *Regional Studies*, Vol 33, 84-89.
- ROND, P. & HUSSLER, C. (2005) Innovation in regions: What does really matter? *Research Policy*, 34, 1150-1172.
- ROOS, J., KLEINE, D. & VON KROGH, G. (1998) *Knowing in firms : understanding, managing and measuring knowledge*, London, Sage.
- ROSENBERG, N. (1976) *Perspectives on Technology*, Cambridge, Cambridge University Press.
- ROSENBERG, N. (1982) *Inside the Black Box: Technology and Economics*, Cambridge Cambridge University Press.
- ROTH K. AND NIGH D. (1992) The effectiveness of HQ-subsidary relationship. *Journal of Business Research*, 25, 277-301.
- RUIGROK W. AND ACHTENHAGEN L. AND RUEGGSTURM J. AND WAGNER M. (2000) Hilti AG: Shared Leadership and the rise of the communicating Organization. IN PETTIGREW, A. F. (Ed.) *The Innovating Organization*. London, Sage Publication Ltd.
- RUMELT R.P. AND STOPFORD J.M. (1996) *Changing managerial logics*, Mimeo, London Business School, January.
- SAAD, M. & ZAWDIE, G. (2005) From technology transfer to the emergence of a triple helix culture: the experience of Algeria in innovation and technological capability development. *Technology Analysis & Strategic Management*, 17, 89-103.

- SABEL, C. (1989) Flexible specialization and the re-emergence of regional economies IN HIRST P. AND ZEITLIN J. (ED.). (Ed.) *reversing Industrial Decline?* . Berg, Oxford.
- SABEL C. (1996) Learning by monitoring: the dilemmas of regional economic policy in Europe. *OECD*.
- SABEL C. AND HERRIGEL G. AND KAZIS R. AND DEEG R. (1987) How to keep mature industries innovation. *Technology Review*, 90, 27-35.
- SAETREN, H. (2005) Facts and Myths about Research on Public Policy Implementation: Out-of-Fashion, Allegedly Dead, But Still Very Much Alive and Relevant. *Policy Studies Journal*, 33, 559-582.
- SAFFORD, S. (2005) Forums Vs. Fountains: Universities and the Evolution of Knowledge Networks in Akron and Rochester. *Academy of Management Proceedings*, pO1-O6.
- SAKO M. (1992) *Price, Quality and Trust: Inter-firm Relations in Britain and Japan*, Cambridge, Cambridge University Press.
- SANCHEZ R. AND MAHONEY J.T. (1996) Modularity, flexibility and knowledge management in product organization design. *Strategic Management Journal*, Winter special, 63-76.
- SANCHEZ-RUNDE C. J. AND QUINTANILLA J. (2000) Initial steps on the path towards new forms of organizing: two experiences within the group Aguas de Barcelona. IN PETTIGREW, A. F. (Ed.) *The Innovating Organization*. London, Sage Publication Ltd.
- SANTORO, M. D. & CHAKRABARTI, A. K. *Building industry-- university research centers: some strategic considerations*.
- SAPSED, J., BESSANT, J., PARTINGTON, D., TRANFIELD, D. & YOUNG, M. (2002) Teamworking and Knowledge Management: A Review of Converging Themes. *International Journal of Management Reviews*, Vol. 4 Issue 1, p71, 15p.
- SARKER, S. V., JOSEPH S.; SARKER, SUPRATEEK (2003) Virtual Team Trust: Instrument Development and Validation in an IS Educational Environment. *Information Resources Management Journal*, Apr-Jun2003, Vol. 16 Issue 2, p35,.
- SAVONA, M. (2003) Innovation in the Service Economy: The New Wealth of Nations: Faiz Gallouj, Edward Elgar Publisher Limited, Cheltenham, UK, Northampton, MA, USA, 2002, 226 pp., Price [UK pound]55.00, ISBN 1-84064-670-5. *Research Policy*, 32, 1716-1717.
- SAXENIAN A AND LI C.Y. (2002) Bay-to-bay strategic alliance: the network linkages between Taiwan and the US venture capital industries. *International Journal of Networking and Virtual Organization*, Vol 1, 17-32.
- SAXENIAN A. (2000) Regional Networks and Innovation in Silicon Valley and Route 128. IN ACS J. Z. (ED.) (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Pinter.
- SBRC (1992) The state of British Enterprise: Growth, Innovation and Competitive Advantage in Small and Medium-sized Firms. . Small Business Research Centre, Department of Applied Economics University of Cambridge.
- SCHARPF F.W. (1978) Interorganizational Policy Studies: Issues, Concepts and Perspectives. IN (ED), K. I. H. A. F. W. S. (Ed.) *Interorganizational Policy Making: Limits to Coordination and Central Control*. London, Sage.
- SCHOENBERGER E. (1991) The Corporate Interview as a Research Method in Economic Geography. *Professor Geographer*, Vol 43.
- SCHOLZ C. (1987) Corporate Culture and Strategy-the problem of strategic fit. *Long Range Planning*, 4, 78-87.
- SCHULTZE U. AND ORLIKOWSKI W J. (2001) Metaphors of virtuality: shaping an emergent reality. *Information and Organization*, Vol 11, 45-77.
- SCHUMPETER J. (1926) *Theorie der wirtschaftlichen Entwicklung: eine Untersuchung uber Unternehmengewinn, Kapital, Kredit, Zins und den Konjunkturzyklus*, Munchen and Leipzig:, Duncker & Humbolt.
- SCHWARTZ, J. (2005) If You Want to Lead, Blog. *Harvard Business Review*, 83, 30-30.
- SCHWARZER B. AND H. KREMAR (1994) New Organization Models. *Information Management*, Vol. 9, pp. 20-27.
- SCOTT A. (1988) Flexible production systems and regional development: the rise of new



- industrial spaces in North America and Western Europe. *International Journal of Urban and Regional Research*, Vol 12, pp. 171-185.
- SCOTT W.R. (1990) Technology and Structure: an organizational-level perspective. IN GOODMAN P.S., S. L. S. (Ed.) *Technology and Organizations*. Oxford, San Francisco, Jossey-Bass Publishers.
- SHAN W. AND WALKER G. AND KOGUT B. (1994) Interfirm cooperation and start up innovation in teh biotechnology industry. *Strategic Management Journal*, 15, 387-394.
- SHANE, S. & STUART, T. (2000) Organizational endowments and the performance of university start-ups. *Mimeo, University of Maryland*.
- SHANI A.B.AND SENA J.A. (1994) Informationa Technology and the integration of change: sociotechnical system approach. *Journal of Applied Behavioural Science*, 30, 247-270.
- SHATTOCK, M. (1999) The Impact of a New University on its Community: the University of Warwick. IN GRAY HARRY (ED.) (Ed.) *Universities and the Creation of Wealth*. The Society for Research into Higher Education & Open University Press.
- SHIMA, W. T. (2004) The implications of privatization for innovation in Brazilian telecommunications. *International Journal of Technology Management & Sustainable Development*, 3, 3-16.
- SHUTT J. (2000) New Regional Development Agencies in England: Wicked Issues. IN J., B. G. A. G. (Ed.) *Regional Development Agencies and Business Change*. Ashgate.
- SIEBER P. AND GRIESE J. (1998) Virtual organizing as a strategy for the "Big Six" to stay competitive in a global market. *The Journal of Strategic Information Systems*, Vol 7,, 167-181.
- SILTKIN S.B. AND ROTH N.L. (1993) Explaining the limited effectiveness of legalistic remedies for trust/distrust. *Organization Science*, 4, 367-392.
- SILVERMAN, D. (2001) *Interpreting Qualitative Data: Methods for anlaysing talk, text and interaction* Sage Publications
- SILVERMAN D. (1985) *Qualitative Methodology and Sociology*, Aldershot, Hants : Gower.
- SIMME, J. M. & SENNETT, J. (1999) Innovative clusters: global or local linkages? *National Institute Economic Review*, 170, 87-98.
- SIMMIE, J. M. (2002) Knowledge Spillovers and the reasons for the concentration of innovative SMEs. *Urban Studies*, 39, 885-902.
- SIMON H. (1967) The Changing Theory and changing practice of public administration. IN I. DE S. POOL (ED). (Ed.) *Contemporary Political Science*. McGraw - Hill.
- SLIVERMAN, D. (2000) *Doing Qualitative Research: A Practical Handbook*Sage
- SMITH, H. (1997) National Laboratories and Regional Development: Case Studies from the UK, France and Belgium. IN SIMMIE JAMES(ED.). (Ed.) *Innovation, Networks and Learning Regions?* London, Jessica Kinsley Publishers Ltd.
- SMITH R. (1995) The development of new management style. IN EVANS L. AND JOHNSON P. AND THOMAS B. (Ed.) *The Northern Region Economy*. Mansell.
- SNOW C.C. AND LIPNACK J. AND STAMPS J. (1999) The virtual organization: promises and payoffs, large and small. IN COOPER C.L. AND ROUSSEAU D.M. (Ed.) *Trends in Organizational Behaviour*. John Viley & Sons Ltd.
- SNOW C.C. AND MILES R.E. AND COLEMAN JR H.J. (1992) Managing 21st Century Network Organizations. *Organizational Dynamics*, 20, pp 5-21.
- SNOWDEN, D. J. (2002) Complex act of knowing: Paradox and Descriptive of awareness *The Journal of Knowledge Management* Vol 6, 100-111.
- SOCITM. (1998) Modernizing Local Government. Embracing the Information Age. Northampton: Society of Information Technology Management.
- SPARROW P.R. AND DANIELS K. (1999) Human Resource Management and Virtual Organizations: Mapping the Future Research Issues. IN COOPER C.L. AND ROUSSEAU D.M. (Ed.) *Trends in Organizational Behaviour*. John Viley & Sons Ltd.
- SPRU. (2001) The Economic Returns to Basic Research and the Benefits of University - Industry Relationships. Science and Technology Policy Research.
- STALLINGS D. (2001) The virtual university: organizing to survive in the 21st Century. *The Journal of Academic Librarianship*, Vol 27, 3-14.

- STANDAGE T. (1998) *The Victorian Internet*, Weidenfeld & Nicolson.
- STEENHUIS, H.-J. & GRAY, D. O. (2006) Cooperative research and technology dynamics: the role of research strategy development in NSF Science and Technology Centres. *International Journal of Technology Transfer & Commercialization*, 3-3.
- STEHR, N. (1994) *Knowledge Society*, London, Sage.
- STERNBERG R. (2000) University - Industry Relationships in Germany and their Regional Consequences. IN ACS J. Z. (ED.) (Ed.) *Regional Innovation, Knowledge and Global Change*. London and New York, Pinter.
- STEVENS, J. M., BEYER, J. M. & TRICE, H. M. (1980) Managerial Receptivity and Implementation of Policies *Journal of Management*, 6, 33-54.
- STEWART, F. & CONWAY, S. (2000) Building Networks for Innovation Diffusion in Europe: Learning from the SPRINT Programme. *Enterprise & Innovation Management Studies*, 1, 281-301.
- STEWART T.A. (1992) The search for the organization of tomorrow. *Fortune*, 125, 92-98.
- STOHL C. (1995) *Organizational Communication: Connectedness in Action*, Sage Publications.
- STOKER, R. P. (1991) *Reluctant Partners: Implementing Federal Policy* Pittsburgh University of Pittsburgh Press
- STONE, N. Leading Change, Changing Leadership. *Harvard Business Review*, 73, 16.
- STRATI A. (2000) *Theory and Method in Organization Studies*, Sage Publications.
- STRATIGEA A AND GIAOUTZI M. Virtual Perspectives as Policy Making Tools in Urban and Regional Planning.
- STUART T. (1998) Network positions and propensities to collaborate: an investigation of strategic alliance formation in a high technology industry. *Administrative Science Quarterly*, 43, 668-698.
- STYLES K. AND GOLDSWORTHY M. (2002) Go extranet: a case study in applying technology for competitive advantage. *International Journal of Networking and Virtual Organization*, Vol 1, 82-91.
- SUSSKIND LAND CRUIKSHANK J. (1987) *Breaking the Impasse: Consensual Approaches to Resolving Public Disputes*, New York, Basic Books.
- SWAN, J. & SCARBROUGH, H. (2005) The politics of networked innovation *Human Relations*, 58, 913-943.
- TÄDTLING, F. & TRIPPL, M. (2005) One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy*, 34, 1203-1219.
- TAPSCOTT D; (1995) *The Digital Economy: Promise and Peril in the Age of Networked Intelligence*.
- TASHAKKORI A. & TEDDIE C. (1998) *Mixed Methodology: Combining quantitative and qualitative approaches*, Thousand Oaks, CA: Sage.
- TEISMAN, G. R. & KLIJN, E.-H. (2002) Partnership Arrangements: Governmental Rhetoric or Governance Scheme? *Public Administration Review*, 62, 197.
- TERMEER C.J.A.M. AND KOPPENJAN J.F.M. (1997) Managing Perceptions in Networks. IN KICKERT J.M. WATER. AND KLIJN ERIK-HANS (ED). (Ed.) *Managing Complex Networks: Strategies for the Public Sector*. Sage Publication Ltd.
- THE COMPETIVENESS WHITE PAPER: BUILDING THE KNOWLEDGE DRIVEN ECONOMY (1998), UK DTI [http://www.dti.gov.uk/comp/competitive/wh\\_intl.htm](http://www.dti.gov.uk/comp/competitive/wh_intl.htm) .
- THOMAS J.M. AND BENNIS W. G. (1972) *Management of Change & Conflict*, Middlesex England, Penguin Books Ltd.
- THOMPSON G.F. (2003) *Between Hierarchies & Markets: The Logic and Limits of Network Forms of Organization*, Oxford Univeristy Press.
- THOMPSON P. AND MCHUGH D. (1995) *Work Organizations: A critical introduction*, London, Macmillan Business.
- THURSBY, J. G. & THURSBY, M. C. (2000) Who is selling the ivory tower? sources of growth in university licensing. *NBER Working Paper 7718*.
- TIDD, J. (2001) Innovation management in context: environment, organization and performance. *International Journal of Management Reviews*, Vol. 3 Issue 3;, 169-183.

- TIWANA, A. & BUSH, A. A. (2005) Continuance in Expertise-Sharing Networks: A Social Perspective. *IEEE Transactions on Engineering Management*, 52, 85-101.
- TOBERT P.S., S. G. R., KRACKHARDT D., ANDREWS S.B., (1995) Review essay: wanted: a good network theory of organization. *Administrative Science Quarterly*, 40, 343.
- TOFFLER A. (1981) *The Third Wave*, New York, Bantam Books.
- TOFFOLON-WEISS, M. M., BERTRAND, J. T. & TERRELL, S. S. (1999) The Results Framework-An Innovative Tool for Program Planning and Evaluation *Eval Rev*, 23, 336-359.
- TOLMIE P AND HUGHES J AND ROUNCEFIELD M AND SHARROCK W. (1998) The Virtual manager?: change and continuity in managerial work. *Department of Sociology, Lancaster University*, <http://www.comp.lancs.ac.uk/sociology/papers/tolmie-el-alvirtual-manager.pdf>.
- TOMANEY, J. (2000) End of the empire state? new labour and devolution in the United Kingdom. *International Journal of Urban and Regional Research* 24, 677-690.
- TOMLINSON M. (1999) The Learning Economy and Embedded Knowledge Flows in Great Britain. *Journal of Evolutionary Economics*, Vol 9, pp 431-451.
- TOWNSEND A.M. DEMARIE S.M. & HENDRICKSON A.R. (1998) Virtual Teams: Technology and the Workplace of the Future. *Academy of Management Executive*, August,, 12(3):, 17-29.
- TRUDEAU, M. & MARTIN, F. (1999) Measuring the Economic Impact of Universities: Canada. IN GRAY HARRY (ED.) (Ed.) *Universities and the Creation of Wealth*. The Society for Reserach into Higher Education & Open University Press.
- TULLY, S. (1993) The Modular Corporation. *Fortune*, February 8, 106-114.
- TURNER B.A. (1988) Connoisseurship in the study of organizational cultures. IN BRYMAN A (ED.). (Ed.) *Doing Research in Organizations*. Routledge.
- TUUNAINEN, J. (2005) Contesting a Hybrid Firm at a Traditional University. *Social Studies of Science (Sage)*, 35, 173-210.
- UICHOL K. AND HANGUK SIMNI HAKHOE. (1994) *Individualism and collectivism : theory, method, and applications*, Thousand Oaks, Calif., Sage Publications.
- UZZI, B. & DUNLAP, S. (2005) How to Build Your Network. *Harvard Business Review*, 83, 53-60.
- UZZI B. (1997) Social structure and competition interfirm networks: the paradox of embeddedness. *Administrative Science Quarterly*, 42, 35-67.
- VAN AKEN, J. E. & WEGGEMAN, M. P. (2000) Managing learning in informal innovation networks: overcoming the Daphne-dilemma. *R & D Management*, 30, pp 139-149.
- VAN BUEREN, E. M., KLIJN, E.-H. & KOPPENJAN, J. F. M. (2003) Dealing with Wicked Problems in Networks: Analyzing an Environmental Debate from a Network Perspective. *Journal of Public Administration Research & Theory (Oxford University Press)*, 13, 193.
- VAN DE VEN, A. H., ANGEL, H. L. & POOLE, M. S. (1989) *Research in the Management of Innovation: The Minnesota Studies:*, New York: Harper & Row.
- VAN DEN BOSCH F.A.J., V. W. R. A. (2000) Creation of Managerial cappableilities through managerial knowledge integration: a competence-based perspective. IN SANCHEZ R., H. A. (Ed.) *Knowledge Management Organizational Competence*. Chicester, John Wiley.
- VAN DEN DAELE, W. & KROHN, W. (1998) Experimental implementation as a linking mechanism in the process of innovation. *Research Policy*, 27, 853-868.
- VENKATRAMAN N. AND HENDERSON J.C. (1998) Real Strategies for Virtual Organizing. *Sloan Management Review*, Fall, 33-48.
- VERBEEK, A., DEBACKERE, K., LUWEL, M. & ZIMMERMANN, E. (2002) Measuring progress and evolution in science and technology " I: The multiple uses of bibliometric indicators. *International Journal of Management Reviews*,, Vol. 4 Issue 2, p179, 33.
- VICKERS I AND NORTH D. (2000) Regional Technology Initiatives: Some Insights from the English Region. *European Planning Studies*, Vol 8, pp 302-318.
- VON KROGH, G. (2003) *Networks of Innovation: Change and Meaning in the Age of the Internet: I. Tuomi*, Oxford University Press, 2002, 251 pp., Price [UK pound]25.00, ISBN: 0-19-025698. *Research Policy*, 32, 1714-1716.

- VON KROGH, G., ICHIJ\*O, K. & NONAKA, I. O. (2000) *Enabling knowledge creation : how to unlock the mystery of tacit knowledge and release the power of innovation*, Oxford, Oxford University Press.
- VOSS H. (1996) Virtual Organizations: The Future is Now. *Strategy & Leadership*, July/August, 24(4):, 12-16.
- WALKER G. AND KOGUT B. AND SHAN W. (1997) Social capital, structure holes and the formation of an industry network. *Organization Science*, 8, 109-125.
- WALSH J.P. AND UNGSON G.R. (1991) Organizational Memory. *Academy of Management Review*, 16, 57-91.
- WALSHAM G. (1993) *Interpreting Information Systems in Organizations*, John Wiley and Sons, Chichester.
- WEBSTER, A. & ETZKOWITZ, H. (2000) The future of the university and the university of the future: evolution of ivory tower. *Research Policy*, 29, 313.
- WEICK K. (1979) *The Social Psychology of Organizing*, Reading, MA: Addison-Wesley.
- WEICK K. E. (2001) *Making Sense of Organization*, Blackwell Publishers Ltd.
- WEICK K.E. (1990) Technology as Equivoque: Sensemaking in New technologies. IN GOODMAN P.S. AND SPROULL L.S. (Ed.) *Technology and Organizations*. Oxford, San Francisco, Jossey-Bass Publishers.
- WEINER M. AND NOHRIA N. AND HICKMAN A. AND SMITH H. (1997) Value networks - the future of the US electric utility industry. *Sloan Management Review*, Vol 38, 21-40.
- WENGER, E. (1999) *Communities of Practices* Cambridge University Press.
- WENGER E. (1998) *Communities of Practice: Learning, Meaning and Identity*, New York, Cambridge University Press.
- WEST J. (2000) Institutions, information processing, and organization structure in research and development: evidence from the semiconductor industry. *Research Policy*, Vol 29, 349-373.
- WHEATLEY, M. J. (1992) *Leadership and the New Science: Learning About Organizations from an Orderly Universe*.  
, San Francisco: , Berrett-Koehler, .
- WHITE H.C. (1992) Cases are for identify, for explanation, or for control. IN C.C. RAGIN, H. S. B. (Ed.) *What is a case? Exploring the foundations of social inquiry*. Cambridge, Cambridge University Press.
- WIDE'N-WULFF, G. (2003) Information as a resource in the insurance business: the impact of structures and processes on organization information behaviour. *The New Review of Information Behaviour Research*.
- WIESENFELD B. AND RAGHURAM S. AN GARUD R. (1998) Communication patterns as determinants of organizational identification in a virtual organization. *Journal of Computer mediated communication*, Vol 3.
- WIEVIOR KA M. (1992) Case studies: history or sociology. IN C.C. RAGIN, H. S. B. (Ed.) *What is a case? Exploring the foundations of social enquiry*. Cambridge, Cambridge University Press.
- WIJK A.VAN R. AND BOSCH A.J.VANDEN. F. (2000) The emergence and development of internal networks and their impact on knowledge flows: the case of Rabvobank Group. IN PETTIGREW M.A. AND FENTON M.E. (Ed.) *The Innovating Organization*. Sage Publications Ltd.
- WILKES, S. & WRIGHT, M. (1987) *Comparative Government-Industry Relations*, Oxford, Clarendon Press.
- WILLIAMS, P. (2003) Transforming scientific knowledge. *Information World Review*, 36.
- WILSON L.G. AND LLOYD GOODALL JR H. AND WAAGEN L.C. (1986) *Organizational Communication*, Harper & Row Publishers.
- WINSLOW F.E. (2002) When Government Works, Collaborating to Save Lives. *Leader to Leader*, 6-8.
- WINTER, S. (1988) On Coase, Competence and the Corporation. *Journal of Law, Economics and Organization*, Vol 4, 163-180.

- WOFFORD J.C. AND GERLOFF E.A. AND COMMINS R.C. (1977) *Organizational Communication: The keystone to managerial effectiveness*, McGraw-Hill Series in Management.
- WOGNUM P.M. AND FABER E.C.C. (2002) Infrastructures for collaboration in virtual organization. *International Journal of Networking and Virtual Organization*, Vol 1, 32-55.
- WOLFE D.A. (2000) Networking among regions: ontario and the four motors for Europe. *European Planning Studies*, Vol 8.
- WOLFF M. (1995) *Ki-Net- New Organizational Structures for Engineering Design*.
- WONG P. K. (2002) Globalization of US, European and Japanese Production networks and the growth of Singapore electronics industry. *International Journal of Networking and Virtual Organization*, Vol 1, 55-62.
- WRAY F. (2004) DTI/RSA Conference: Knowledge Economy and the Regions.
- WREN, C. (1999) Competitiveness, Localised Learning and Regional Development: Specialisation and Prosperity in Small Open Economies. *Economic Journal*, 109, pF800-F802.
- WRIGHT S. (1994) *Anthropology of Organizations*, London, Routledge.
- WYNARCZYK, P. & RAINE, A. (2005) The performance of business incubators and their potential development in the north east region of England. *Local Economy*, 20, 205-220.
- YANOW, D. (1987) Toward a policy culture approach to implementation *Policy study review* 7.
- YANOW, D. (1996) *How does a policy mean? interpreting policy and organizational actions*, Washington DC, Georgetown University Press
- YEN D AND HAVELKA D AND CHOU D. C. (2002) Virtual Private Networks: a model for assessing alternatives. *International Journal of Networking and Virtual Organization*, Vol 1, 92-112.
- YIN R.K. (2003) *Case study research: Design and methods*, Sage Publications Thousand Oaks.
- YLIJOKI, O.-H. (2005) Academic nostalgia: A narrative approach to academic work. *Human Relations*, 58, 555-576.
- ZEFFANE R. (1995) The widening scope of inter-organizational networking: economic sectoral and social dimensions. *Leadership & Organization Development Journal*, 16, 26-33.