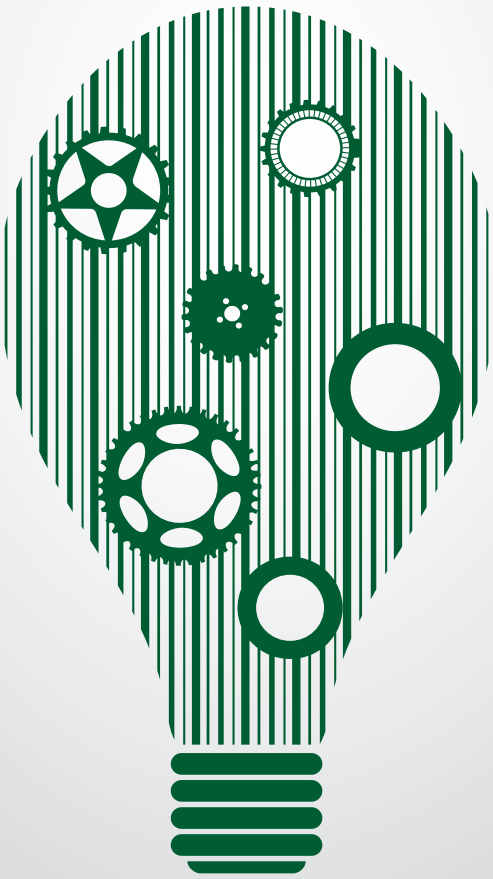
REGIONAL INNOVATION

Government policies and the role of Higher Education Institutions



Patrick Dubarle & Yali Woyessa

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In 1995 he became the principal administrator at the OECD Public Governance and Territorial Development Directorate. Since the beginning of the last decade he coordinated or contributed to more than fifteen territorial reviews at national and regional level. He was also in charge of a programme on Higher Education and Region, and within this framework he provided expertise for eleven case studies in member and non-member countries.

He left the OECD secretariat in 2008 and is now an independent international consultant working for international organisations such as the World Bank, the OECD and the European Investment Bank (EIB), as well as an expert for the Hungarian Government.

Yali Woyessa is a graduate of Addis Ababa University in Ethiopia. He obtained his master's degree from ENSAM in France in Water and Environment Management. He also holds an MA, MBA and PhD from the University of the Free State in South Africa.

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LIST OF ABBREVIATIONS

ABDI	Brazilian Agency for Industrial Development
ANPROTEC	Association for the Promotion of Innovative Organisations
ASRT	Academy of Scientific Research and Technology
AUC	American University in Cairo
BIC	Business Innovation Centres
BNDES	National Bank for Social and Economic Development
BRICS	Brazil, Russia, India, China and South Africa
CAPES	Brazilian Federal Agency for the Support and Evaluation of Graduate Education
CEFET	Federal Centre for Technological Education
CIIC	Commercial International Investment Company
CMRD	Centre for Metallurgical R&D
CNDI	National Council for Industrial Development
CNPq	National Council for Science and Technology
CNTP	Comprehensive National Territorial Plan
CONFAP	National Council of State Research Agencies

CONSECTI	Council of Science, Technology and Innovation Secretaries of State
CRITTS	Regional Technology Transfer Centres
DI	Daedok Innopolis
DLS	Daily Living Sphere
EIA	Egyptian Incubator Association
EIIF	EU Egypt Innovation Fund
EIS	European Innovation Scoreboard
EMBRAPA	Brazilian Agricultural Research Corporation
ENCTI	National Strategy for Science Technology and Innovation (2012–2015)
EPO	European Patent Office
ERA	European Research Area
ERDC	Economic Regional Development Committee
ERDP	Economic Regional Development Plan
EU	European Union
FAPEMIG	Foundation for R&D Support of Minas Gerais
FAPERJ	Foundation for R&D Support of Rio de Janeiro
FAPEST	Foundation for R&D Support of Sao Paulo
FDI	Foreign Direct Investiment
FEZ	Free Economic Zone
FINEP	Research and Projects Financing Agency
FNDCT	National Fund for Science and Technology Development
GAFI	General Authority for Investment
GCI	Global Competitive Index
GDP	Gross Domestic Product
GRI	Government Research Institute
GUC	German University in Cairo
HE	Higher Education
HEI	Higher Education Institution
HEIF	Higher Education Innovation Fund
HKPC	Hong Kong Productivity Council
ICT	Information and Communication Technology
ILP	Industrial Liaison Programme
IMC	Industrial Modernisation Centre
INMETRO	National Institute of Metrology, Quality and Technology
INPI	National Institute of Intellectual Property
IPA	Investment Promotion Agency

IPCC	Intergovernmental Panel on Climate Change
IPO	Initial Public Offering
IPR	Intellectual Property Rights
IT	Information Technology
JIT	Just-In-Time
JPC-SED	Japan Productivity Centre for Socio-Economic Development
JTF	Jordan Technological Fund
KAERI	Korea Atomic Energy Research Institute
KAIST	Korea Advanced Institute of Science and technology
KARI	Korea Aerospace Research Institute
KICOX	Korea Industrial Complex Corporation
KIPO	Korea Intellectual Property Office
KIST	Korea Institute of Science and Technology
KISTEP	Korea Institute of Science and Technology Evaluation and Planning
KOMPSAT	Korea Multipurpose Satellite
KRIBB	Korea Research Institute of Bioscience and Biotechnology
K-STAR	Korea Superconducting Tokamak Advanced Research
KTP	Knowledge Transfer Partnership
LIDC	Localised Industry Development Centre
MCTI	Ministry of Science Technology and Innovation
MEC	Ministry of Education
MENA	Middle East and North Africa
MEP	Manufacturing Extension Partnership
MEST	Ministry of Education, Science and Technology
METF	Middle East Technology Fund
MHSER	Ministry of Higher Education and Scientific Research
MIDIC	Ministry of Industrial Development and Trade
MIN	Ministry of National Integration
MIT	Massachussets Institute of Technology
MKE	Ministry of Knowledge Economy
MLTM	Ministry of Land, Transport and Maritime Affairs
MUCSAT	The City of Scientific Research and Technology Applications
NFRI	Nuclear Fusion Research Institute
NRC	National Research Centre
NTBF	New Technology Based Firms
NURI	New Universities for Regional Innovation

OECD	Organisation for Economic Cooperation and Development
PACTI	Action Plan for Science Technology and Innovation (2007–2010)
PDP	National Production Development Policy
PE	Private Equity
PESEX	Programme to Support Exports
PINTEC	Survey of technological innovation
PNDR	National Policy for Regional development
POSTECH	Pohang University of Science and Technology
PRO	Public research Organisation
PROMESO	Promotion of the Sustainability of Subregional Areas
R&D	Research and Development
RDI	Research, Development and Innovation
RIC	Regional Innovation Centre
RIS	Regional Innovation Systems
ROK	Regions of Knowledge
RSII	Regional Summary Innovation Index
SAS	Science Age Society
SEBRAE	Support Services for Micro and Small Enterprises
SENAI	National Service for Industrial training
SEPI	Skill Enhancement Partnership Initiative
SER	Supra Economic Region
SFD	Social Fund for Development
SME	Small and Medium size Enterprises
SOFTEX	Association for the Promotion of Brazilian Software Excellence
SSI	Small Scale Industry
STDF	Science and Technology Development Fund
TT	Technology Transfer
TTIC	Technology Transfer and Innovation Centre
TTO	Transfer of Technology Office
UNIDO	United Nations Industrial Development Organisation
VC	Venture Capital
WEF	World Economic Forum
WIPO	World Intellectual Property Organisation

FOREWORD

It will become evident in this book that sustainable socioeconomic development, essentially the triple bottom line of social, economic and environmental development, requires at least four pillars in order for it to attain its objectives.

The networks that role players build amongst themselves and the institutions they operate within comprise the first pillar. The second pillar consists of the innovations these networks bring to bear. The third pillar refers to the choice of location and concentration of such innovations in the region. The fourth pillar entails the national and regional policies that will help to interweave all the rest of the pillars together into an ecosystem. This book focuses mostly on the last pillar.

In March 2010 the Council (the apex governing body) of the Central University of Technology, Free State (CUT) in South Africa, adopted a vision that demands of the university to be engaged in order to produce social and technological innovations towards socioeconomic development – primarily in the central region of South Africa. The latter consists mainly of the Free State province, parts of the Northern Cape, and other neighbouring parts of the Eastern Cape, North West, Gauteng and Lesotho. These parts constitute the educational feeder area of CUT.

As part of making sense of this vision, CUT participated in the third round of reviews of the contributions of Higher Education (HE) to city and regional development – especially through innovation – held by the Organisation for Economic Cooperation and Development (OECD) in October 2010. This had been commissioned by the Free State provincial government and its knowledge partners, which includes the University of the Free State (UFS) and CUT.

I should hasten to reveal that in recent years, when South Africa appeared wanting to be an African trailblazer in education, research and innovation, the OECD has conducted a number of reviews: a review of national policies for education in South Africa (2008); a review of South Africa's innovation policy (2010); a review of South Africa's economy (2010); and a review of HE in regional and city development in the Free State (2012).

Sadly, the gross domestic expenditure on research and development (GERD) in South Africa has not improved. It currently hovers at 0.76%, lowest of all the BRICS nations (Brazil, Russia, India, China and South Africa). India, scoring second lowest, is at 0.87%. The latter, which has peaked at 0.95%, is at a level South Africa used to be a few years ago. Clearly knowledge, research and innovation centres like universities have their work cut out for them.

Since the days of these reviews – especially the 2010 review of the Free State – there have been several engagements between CUT and international experts in the fields of innovation and entrepreneurship. These engagements have, amongst other things, led to the establishment of a Regional Innovation Forum

Free State (RIFFS), which brings together all the role players in the region (including the UFS and CUT).

In the context of the work of the OECD in South Africa, several workshops, further studies and study tours have been undertaken by CUT to find the best ways to implement our vision and to make our contribution regionally and beyond. The workshop that took place in January 2012, facilitated mainly by Patrick Dubarle, a retired member of the OECD and hosted by the Faculty of Engineering and Information Technology of CUT, was the first post-review engagement of CUT on how to deploy innovation in the region.

World regions are seen as cauldrons of societal development that have gained currency over the last few decades. Simply put: nations do not just spawn development equitably and evenly throughout their landmasses. Regions provide the backbone and spawn broader national development within themselves through drive, initiative, innovation, networks, and the comparative and competitive advantages that emanate from all these factors. Ultimately, a successful country emerges.

There are examples of this everywhere in the world: the motor industry in Germany focused on the regions of Baden-Württemberg in the southwest and Bavaria in the southeast; the successful region of Daegu in South Korea that specialises in textile manufacturing; the region of Catalonia in Spain that is the backbone of the whole Spanish economy; Silicon Valley in the Unites States of America; and many other regions of the world that the programme of regional reviews of the OECD has educated us on.

I am delighted that through this book CUT is demonstrating that our vision is not just limited to practical implementation, but extends to researching, innovating and educating South Africa and the world about how universities could engage more deeply and with greater meaningfulness in regional development.

The focus of this book on innovation policy and instruments is very important in a unitary state like South Africa. Whilst the recommendations of the OECD – especially on innovation – have clearly shown that South Africa needs to coordinate its activities much better at national and regional levels, policy may not have moved quickly enough to allow the ecosystem to work seamlessly. The Department of Science and Technology of South Africa has been working tirelessly to cascade the national system of innovation to the country's regions. However, these areas do not have structures in place to manage regional development. Whilst provinces have departments of social and economic development and others, the ones that have to drive and support innovation are non-existent.

As the book clearly suggests, it is not just coordination and management structures that we need for regional innovation to thrive, we also need coordination at the level of mechanisms, platforms and instruments for

innovation. Thus, beyond just government leadership in policy and structure, there is a lot that the quad-helix of government, universities, business/industry and broader organs of civil society should do to coordinate innovation instruments amongst themselves. We need seamless planning, the pooling together of resources and execution by all partners.

I have fervent hope that this book will inspire us all towards regional innovation and ultimately regional development. I am proud that our meagre intellectual and practical efforts at CUT have helped us to do this.

On behalf of CUT, I will forever be indebted to the authors of this book and to our Faculty of Engineering and Information Technology – especially the Dean, Prof. Alfred Ngowi. Thanks are also extended to our Deputy Vice-Chancellor: Academic and Research, Prof. Henk de Jager, who provided the authors resources, time and space to write; to our Dean for Research and Innovation, Prof. Laetus Lategan, who provided research related support to complete this project; and, most importantly, to the whole university for the support it provided to the faculty to engage in this important work.

Thandwa Mthembu

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Central University of Technology, Free State (CUT)

14 January 2015

INTRODUCTION

Innovations, i.e. new products and processes, are introduced to markets through dynamic entrepreneurs, the development of successful projects and efforts to respond to consumer, as well as manufacturing and service industry demand. Innovation often requires market-relevant research and development (R&D) investment, creativity and cooperation between Higher Education Institutions (HEI) and firms. However, technology markets are often characterised by suboptimal conditions and governments are called upon to bridge the gap. Firstly, the outcomes of innovation are highly uncertain, making firms and entrepreneurs reluctant to invest sufficiently in R&D. Secondly, risk-averting behaviour often stifles creativity in firms. Thirdly, collaboration between firms themselves and between firms and other research institutions is underdeveloped, due to the lack of an enabling environment and the difficulty in appropriating the economic benefits of investment in innovation.

In general, public policy to support innovation has been grounded in the assumption that there are market failures that lead to significant underinvestment in research and innovation across the economy. Other sources of suboptimal outcomes include the capability of potential innovators to act in their own best interests, institutional rigidities (i.e. inadequacies of these institutions to contribute to innovation), as well as network and coordination problems. Increasingly innovation is considered as a product of systems involving several actors including not only firms, but also institutions and intermediaries. Innovation policy and support to innovators need to be designed to respond to these systemic failures.

The growing decentralisation of innovation policies goes hand in hand with the need to improve the efficiency of support to innovators. Local authorities can be more selective when they target recipient firms. They have knowledge and better information about high potential local firms and can better assess the risks linked with local or regional innovation. This change does not only affect federal, but also unitary, countries. Innovation is increasingly considered as a crucial driver of regional development. It seems that the regional policy of the European Union (EU) is gradually shifting its emphasis on new products and processes.

The book summarises several seminars that were hosted by the Faculty of Engineering and Information Technology of the Central University of Technology, Free State, at the end of January 2012 in Bloemfontein, South Africa. It proposes a realistic approach to innovation. In most countries – and especially the developing world – innovation is not something entirely new, but something new in society, which if broadly disseminated brings significant economic, social and environmental change. The seminars offered a comprehensive view of innovation policies and emphasised not only the support to innovators through financial measures, but also efforts to remove regulatory and institutional obstacles to innovation. The focus also fell on initiatives to strengthen the knowledge-base notably through investment in education and research. Attention was also

given to assessment procedures, which, even if they are difficult to implement, are crucial to building coherent innovation strategies and to fine-tune policies and programmes.

This book attempts to cast some light on the innovation machinery and to help better understand the dynamics of innovation. It prioritises a few policy approaches centred on the regional perspective, the role of the Higher Education system, and the support to innovators. It leaves aside numerous fields of analysis such as the impact of climate change, the transition to a green economy, the multilevel governance of innovation policies and the social aspects of innovation.

The first chapter of this book revisits major concepts and assumptions underpinning the reflection about innovation and the role of regions in that context. It focusses on the mechanics of innovation and its underlying factors and makes recourse to some statistics and indicators, though these often underline the need for further investigations on these issues.

To explain the role of government in innovation, it is interesting to refer to the gardener metaphor (World Bank, 2010). In fact, government can usually focus on a few generic functions comparable to nurturing plants to help them grow. It can facilitate the articulation and implementation of innovative initiatives, since innovators need basic technical, financial and other support (watering the plant). Government can reduce obstacles to innovation in competition, as well as regulatory and legal frameworks (removing the weeds and pests). Government sponsored R&D structures can respond to the needs and demands of surrounding communities (fertilising the soil). These issues will be dealt with in chapter two.

Governments can also legitimately impose and fund the adaptation of the educational, research and other knowledge sources that are required to cope with deep and rapid technical changes. The educational system in particular can help form a receptive and creative population (preparing the ground). This is a very important part of innovation policy-making that is often overlooked. These issues will be addressed in chapter three.

The fourth and final chapter will focus on three national examples, Brazil, Egypt and Korea, emphasising their geographical, economic and cultural contexts. These countries have been chosen outside the 'traditional' highly developed world to show how innovation policies are diffusing to catching up less developed countries with different level of development.

Note to readers:

The events and policies reported in this book were applied before 2012, mainly during the period of 2000–2010.

CHAPTER 1

REGIONAL INNOVATION: CONCEPTS, PRINCIPLES AND POLICY TRENDS

1. Introduction

Technological innovation has always been at the heart of economic and social development. As such it is essential not only to further evolution of advanced countries, but also to the future of the developing world. In this context innovation should be understood as the dissemination of something new in a given environment, and sometimes as something new in absolute terms. While economically advanced countries naturally work at the technological frontier, developing countries have considerable opportunities for tapping into global knowledge and techniques for dissemination in their domestic context. This ability will be decisive for initiating new activities, notably in service industries, for improving agriculture and industrial productivity and for increasing overall welfare in areas such as health and nutrition.

Innovation depends significantly on overall conditions in the economy, governance, education and infrastructure. Such framework conditions are particularly problematic in developing countries, but experience shows not only proactive innovation policies are possible and effective, but they also help create an environment for broader reform. Innovation can be approached from an organic and evolutionary perspective. An efficient innovation policy addresses the overall innovation climate which goes far beyond traditional science and technology policy, it also involves many government departments.

2. Regional innovation: Trends, underlying factors and systemic performances

2.1 What is innovation?

The starting point for considering the role of innovation is to be clear on definitions. Innovation is a somewhat nebulous concept. According to a recognised United Kingdom (UK) innovation expert, Professor Kevin Morgan, it is "in general a groping, uncertain, cumulative and path dependent process."

It is clear that innovation is very different from research. Innovation is distinctive because of its economic and commercial imperatives. According to a report of the Department of Trade and Industry in the UK, innovation is quite simply: "the development of new ideas and their economic application as new products or processes" (DTI, 2004). The EU definition emphasises "the commercially successful exploitation of new technologies, ideas or methods through the

introduction of new products or processes or through the improvement of existing ones". Innovation is a result of an interactive learning process that often involves several actors from inside and outside the companies.

This definition is interesting, because it highlights the innovation process as an institutionally and geographically bound process, involving numerous actors often based within close spatial proximity to each other. Innovation is no longer viewed as a simple linear process conducted within the confines of a single firm or 'black box'. Indeed, in adopting a systemic approach towards innovation, there is now a general agreement that innovation involves a network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies (Freeman, 1987; 1995). Therefore, innovation and knowledge are complex and somewhat amorphous concepts which need to be considered in a holistic manner in order to be properly understood.

2.2 Innovation and societies: The long-term view

Systemic transitions have taken place throughout history. In such systemic changes, daily life is profoundly transformed and the ruling class replaced. These changes work their way in society, but change cannot proceed faster than the speed of human adaptation to new technology.

In the Middle Ages, the basic innovation in materials was the use of iron in agriculture (e.g. ploughs), construction and warfare (e.g. weapons). In terms of energy, water mills became non-specialised sources used not only for baking, but also for carpentry, textiles and beverages. The social time scale was defined by the sound of the tolling bells of the belfry. Relation between humans and the biosphere became more systematic with seed selection and cattle breeding (World Bank, 2010). In all these fields, research was mostly taking place in the monasteries (Gutenberg's printing press only emerged in 1450).

> In the Industrial Revolution these four poles were again activated, but the vertical axis moved up in order of magnitude in finesse and complexity. The chronometer measures a tenth of a second rather than the hours of the bells of the belfry in the Middle Ages, and Pasteur's microscope looks at cells and microbes. In fact the Industrial Revolution involved a series of second order revolutions which went along with infrastructures and institutional changes (age of steam and railway from 1829 in Britain; the age of steel, electricity and heavy engineering from 1875 in the United States of America [USA] and Germany overtaking Britain; and finally the age of oil, automobile and mass production mainly in the USA, after 1908 spreading to Europe). The economy had to turn to non-renewable energy, coal and oil, because of overexploitation of forests in 17th and 18th centuries.

With the cognitive revolution, the order of magnitude of the time scale shifts from one tenth of a second to one billionth of a second (nanosecond 100 million thinner) in a first stage and probably even a million thinner again (the femtosecond 10–15) with optical commutation. Materials are now elaborated at molecular level for polymers and biotechnology by manipulating genetic codes also reaching that level. Politicians have promoted the term converging technologies as a nano-bio-info complex. With the new order of magnitude, cellular phones compute in nanosecond, as does the laptop, and the GPS transforms a signal from the satellite to a position on earth with a degree of precision of less than one meter in that time scale.

Also new is the ecological challenge. The fast rise of commodity prices in 2008 (including oil) drew attention to the pressures of excessive demand on limited resources. Demands on environmental resources, such as water and levels of air pollution have also been very high. A particularly serious problem is the impact of increased greenhouse gases on global warming and many excessive weather events took place in 2011: floods, tropical storms, tsunami and earthquakes as never before. The Intergovernmental Panel on Climate Change (IPCC) appointed by the United Nations already concluded in 2007 in its final report that global warming was unequivocal, an increase of 6 °C in 2100 is now forecasted, not 2 °C as initially predicted. Also, it was concluded that it was likely caused by human activities, that it would have serious negative impacts on a wide range of areas and that adaptation and mitigation strategies were critical to managing these risks. Innovation will be crucial to tackle climate change and to secure the better conditions for sustainable development and green growth (World Bank, 2010).

2.3 Innovation and growth

A theoretical digression or conceptual parenthesis is to be explored (see Box 1.1).

Box 1.1: Revisiting the economic analysis of innovation

The economic profession has been somewhat slow to acknowledge the importance of innovation for economic growth. Even Adam Smith, writing in the middle of the Industrial Revolution, was not fully aware of the fundamental nature of the changes in the economic paradigm around him. In the earlier economic models, output (Q) was expressed as a function of capital (K) and labour (L) and technology was assumed away (black box):

$$Q = f(K, L)$$

In 1957 economist Robert Solow became famous for noting that increases in capital and labour did not fully account for economic growth (black matter).

Box 1.1: Revisiting the economic analysis of innovation (Continued)

There was another factor (A) which represented technical change and enhanced the productivity of capital and labour. Thus technology was inserted as a separate factor (A), which augmented the productivity of capital and labour and the equation became:

$$Q = A\ f\ (K, L)$$

Technology was assumed to be exogenous. It took nearly three decades, before Paul Romer in 1986 modelled technology not as exogenous manna from heaven, but as the result of explicit effort. Thus the new growth theory modelled technology (T) as the result of explicit input namely R&D and human capital (HC) as in the following equation:

$$A = f\ (R\&D, HC)$$

A good deal of empirical work has been done on the relationship between growth and the reduced form of basic growth equation where R&D and HC are substituted for technology as in the equation:

$$Q = f\ (K, L, R\&D, HC)$$

Total-factor poductivity (TFP) is an important factor which is the residual for the growth in output that is not explained by the growth in input. Factors other than underlying technology affect the efficiency with which factors are used: ages of capital equipment, utilisation rates, etc. Determinants of TFP include the creation of knowledge (R&D and education) as well as access to foreign knowledge, HC, physical infrastructure, financial systems, trade, institutional regime, and geography as in climate and distance from markets.

Isakson concludes that capital accumulation is a very important determinant of growth of TFP, not only because of capital deepening, but also because more recent equipment tends to embody more productive new technology. HK in the form of education and health is also important. Openness to foreign knowledge is more important than R&D for developing countries. For developing countries, growth equations therefore need to incorporate imports of capital goods and components as well as imports more generally. This also includes foreign direct investment (FDI) and other channels for accessing existing global knowledge.

A major debate in economic literature has centred on whether capital accumulation or technical change is more important for growth. The findings depend very much on the level of development of the country studies. Using conventional analysis, capital deepening explains more than half of the growth rate of output per worker in a majority of countries (Hulten and Isaksson, 2007). The bottom line of the analysis is that innovation as roughly proxied by TFP (or that cannot simply be explained by factor input) is the major contributor to the development levels across countries.

Source: World Bank, 2010.

Innovation is increasingly seen by economists, economic geographers, regional scientists and sociologists as a key element for propelling growth and dynamism within knowledge-based economies. According to the OECD, between 1980 and 2005 more than half of all total growth in output across the developed world resulted from innovation.

Its role has nevertheless changed in recent years. Increased competition and globalisation have spurred a greater market orientation of funding, resulting in strong growth of business R&D and scientific research. This has a direct impact on innovation in key areas such as biotech and information and communication technology (ICT). The latter has also played a role by accelerating the process of knowledge creation: the mapping of the human genome would not have been possible without modern computing technologies. It has also enabled faster networking and made science more efficient.

The OECD's work shows research is a driver of multifactor productivity. Investment in domestic R&D is critical to building local networks and can serve as a gateway for tapping into foreign knowledge and research as it helps to benefit from foreign research.

Returning to numbers, it is interesting to note that the OECD calculations were showing some years ago that with an increase in R&D spending of 0.1% of gross domestic product (GDP), the GDP would grow 1.2% on average over the long term. In other words, the implementation of the Lisbon strategy, an EU plan during the 2000s designed to increase R&D spending levels to 3% of GDP by 2010, was expected to have significant consequences on welfare and job creation. However, these growth effects did not fully materialise with the advent of the financial crisis.

While the benefits for growth, under normal economic conditions of increasing R&D efforts are recognised, countries are nevertheless on an unequal footing with regard to innovation. Despite globalisation, R&D cooperation, growing competition and the diffusion of ICT, their degree of innovation continues to differ considerably.

Box 1.2: World Economic Forum report: Some definitions

In its annual report, the World Economic Forum (WEF) computes a number of indices. Competitiveness is defined as the set of institutions, policies and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the level of prosperity that can be earned by an economy. The productivity level also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a more competitive economy is one that is likely to grow faster over time.

Box 1.2: World Economic Forum report: Some definitions (Continued)

There are many determinants driving productivity and competitiveness. Understanding the factors behind this process has occupied the minds of economists for hundreds of years, engendering theories ranging from Adam Smith's focus on specialisation and the division of labour to the emphasis of neoclassical economists on investment in physical capital and infrastructure. More recently the interest tends to focus on other mechanisms such as education and training, technological progress, macroeconomic stability, good governance, firm sophistication and market efficiency, among others.

While all of these factors are likely to be important for competitiveness and growth, they do not exclude one another – two or more of them can be significant at the same time, and in fact that is what has been shown in economic literature.

This open-endedness is captured within the Global Competitive Index (GCI) by including a weighted average of many different components, each measuring a different aspect of competitiveness.

These components are grouped into twelve pillars of competitiveness:

1. Institutions (legal and administrative framework)
2. Infrastructure (efficiency)
3. Macroeconomic environment (stability)
4. Health and primary education (a healthy workforce is important)
5. Higher education and training (from its quality depends the capacity to move up the value chain)
6. Goods markets efficiency (right mix of products and services)
7. Labour market efficiency (allocation of workers to their most efficient use in the economy)
8. Financial market development (channelling resources to entrepreneurial or investment projects)
9. Technological readiness (agility to adopt new technology)
10. Market size (economies of scale)
11. Business sophistication (quality of business networks and quality of business operations and strategies)
12. Innovations

The GCI assumes that in the first stage of development the economy is factor-driven and competes on the basis of its factor endowments referring to mainly unskilled labour and natural resources (based on pillars 1, 2, 3, 4). In stage 2, countries move into an efficiency driven stage and hinge on pillars 5, 6, 7, 8, 9 and 10. In Stage 3, countries move to the innovation driven stage (characterised by pillars 11 and 12).

Box 1.2: World Economic Forum report: Some definitions (Continued)

Compounded subindexes for infrastructure, higher education and training, technological readiness and innovation include respectively:

a. Indicators for transport infrastructure (50%), for energy and telephone infrastructure (50%).

b. Indicators for the quantity of education which refer to enrolment rates (33%), for quality of education (33%) and on the job training (33%).

c. Indicators for technological adoption which refer to technology transfer (TT) and absorption (50%), for ICT use (50%).

d. Indicators for business sophistication (50%) and innovation (50%).[1]

Source: World Economic Forum, 2013.

This is reflected in Table 1.1 which exhibits the indices of performance and competitiveness of several countries, calculated by the World Economic Forum in its 2014/2015 review (see Box 1.2). Lags with regard to the USA were clear in information technology (IT), innovation and R&D, as well as enterprise environment during the mid-2000s. This leadership is now challenged by Nordic countries and Switzerland.

For innovation and R&D, three groups emerge in Europe.[2] The best performers are Sweden and Finland, followed by the big countries group of Germany, France, the UK and Denmark. Caucasian countries stand at the bottom, with Spain markedly in advance of the rest. Outside Europe and North America, Israel and Japan are clearly ahead for the GCI and for innovation among the 144 countries concerned.

1 Business sophistication indicators include local supplier quantity, quality, state of cluster development, nature of competitive advantage, value chain breadth, control of international distribution, production process sophistication, extent of marketing, willingness to delegate authority and reliance on professional management.

2 Innovation indicators include capacities for innovation, quality of scientific research institutions, company spending on R&D, industry/university collaboration on R&D, government procurement of advanced technology products, availability of scientists and engineers, utility patents and intellectual property protection.

Table 1.1: Country competitiveness (WEF)

Country	Stage	GCI		Infra-structure		HE		Technology-ready		Innovation	
USA	3	5.54	3	5.82	12	5.82	7	5.78	16	5.49	5
Germany	3	5.49	5	6.09	7	5.55	16	5.81	13	5.47	6
France	3	5.08	23	6.03	8	5.26	28	5.77	17	4.74	19
UK	3	5.41	9	6.01	10	5.50	19	6.28	2	4.96	12
Switzerland	3	5.70	1	6.18	5	5.98	4	5.97	10	5.70	2
China	2	4.89	28	4.66	46	4.42	56	3.53	83	3.91	32
Brazil	2.5	4.34	57	3.98	76	4.92	41	4.21	58	3.31	62
Russia	2.5	4.37	53	4.82	39	4.96	39	4.19	59	3.29	65
India	1	4.21	71	3.84	70	3.86	93	2.75	121	3.53	49
South Africa	2	4.35	56	4.29	60	4.04	86	3.86	66	3.64	43
Japan	3	5.47	6	6.13	6	5.44	21	5.61	66	5.54	4
Israel	3	4.95	27	4.99	36	5.00	36	5.78	15	5.56	3
Korea	3	4.96	26	4.83	25	5.38	23	5.42	27	4.83	17
Mexico	2.5	4.27	61	4.19	65	3.99	87	3.55	79	3.31	61
Saudi Arabia	1.5	5.06	29	5.19	30	4.64	57	4.54	45	3.80	33
Egypt	2	3.60	119	3.20	100	3.27	111	3.21	95	2.65	124

Source: World Economic Forum, 2013.

2.4 The regional dimension: Underlying factors and constructed advantages

These differences can best be seen by evaluating the regional dimension of countries. Here it is important to give a sense of the general theoretical basis for examining regions and of the underlying innovation factors.

2.4.1 Theoretical aspects

In spite of increasing economic globalisation, regions are now emerging as important foci of industrial success through their "stock" of specialised know-how, intellectual infrastructure and technological capabilities. The work of Porter has been important in highlighting the importance of regions in constructing competitive advantage, claiming that the conditions "that underlie competitive advantage are indeed often localised within a nation" (Porter, 1990). A major

component of this is because of their unique role in constructing distinctive Regional Innovation Systems (RIS). Huggins states that "regions are the primary spatial unit that compete for the key economic asset in today's knowledge economy. Indeed, knowledge and creativity are the major ingredients that underline the competitiveness of regions" (Huggins, 2004).

Clearly, a key element of regional competitiveness is local knowledge and innovation. Some years ago a review of local development strategies found that in many regions in North America, Europe and Australia, innovation was the core issue for economic development strategy, and success or failure was largely measured on innovation performance (TERU, 2004). As many studies have illustrated, the spatial aspect of the innovation process is central. Main advantages are accrued by firms from spatial co-location. They take three main forms: traditional Marshallian externalities with specific reference to fostering tacit knowledge which is best conducted through face-to-face contact, labour market pooling and "knowledge leakages"; Porterian market conditions referring to demanding customers, rivalry and complementarities; and transportation advantages referring to proximity engendering innovative organisational behaviour such as Just-in-Time (JIT) tactics.[3]

2.4.2 Factor analysis

It has become apparent that regional factors are central to the creation, transfer and absorption of knowledge and innovation. The key ingredients of innovation systems are often regionally based. Undoubtedly there are some issues, such as regulatory matters and patenting, which remain in the domain of either national governments or supra national bodies such as the EU, but these are in the minority compared to the number of factors falling within the remit of regional and local actors and agencies. Indeed, factors such as human capital, development, attraction and retention, industry-university linkages, small and medium-sized enterprises (SME) development and venture capital (VC) are all affected to some extent by local policy factors.

The successful operation of local labour markets is vital for RIC. Although public policies tend to focus on the supply and diffusion of knowledge (science and education policies), the supply of knowledge in the form of educated people is "probably the most important factor influencing the absorption of knowledge" (Dankbaar, 2004). The operation of RIC means that regionally based actors are becoming even more important in the development process, often within very dynamic, high-technology clusters there are very high levels of personal exchanges between firms which create a form of "brain circulation". The

3 One example is suppliers who implement Just-in-Time (JIT) regimes to service the demand requirements of original equipment manufacturers, especially in automotive and electronics manufacturing.

success of the Silicon Valley model is attributed to a free movement of ideas and individuals which generated a "cross-pollination" of ideas and innovation (Saxenian, 1994).

The movement of people between labour markets, sectors and firms has important consequences for industrial functioning and innovation. In fact, important new research seems to empirically verify this thesis. This work discovered that the successful Stockholm ICT cluster exhibits higher rates of inter-firm labour mobility that the rest of the labour market, and higher rates of intra-firm mobility than other comparable private-sector enterprises (Power and Lundmark, 2004). The authors of this work concluded that higher rates of labour mobility seen in this cluster had been beneficial to knowledge diffusion and creation in the components and firms of the cluster (see also Bienkowska, 2011).

A number of studies have discovered the importance that vocational education plays in the development of local innovation systems (Cooke and Morgan, 1991). Specialised courses are devised by local training bodies in close cooperation with members of local industry, universities and other local partners. According to Best, the precision machine and equipment-making capabilities skill-based in Massachusetts have taken nearly two hundred years to develop and have provided "a rich seedbed for new product development, new technological combinations, techno-entrepreneurs and emerging companies."

Indeed, there are some observers who believe that in a knowledge-based economy, training and skills development are much better managed by regional and local actors. The rationale for this is that universities increasingly play a fundamental role in RIC (Cooke, 2004). Boucher *et al* (2003) claim that there are four ways that universities contribute to regional economic development:

a. Their role as economic contributors, which combines measures of the university as an employer, payer of wages and salaries, buyer of products and services from local firms, and attractors of students who spend money in the regional economy.

b. The commodification of knowledge produced in the university through intellectual property rights, technology transfer, science parks and spin-offs.

c. The role of HEI as an attractor, educator and retainer of students, shaping them into knowledge-based graduates for firms in the region/country.

d. Their formal and informal participation as an institutional actor with other actors in linkages and networks of learning, innovation and governance.

Arguably universities also play a key role in the attraction of highly skilled professionals to regional economies. Apart from point a) mentioned above, all aspects of their contribution to the economy impacts on the local innovation milieu. The growing importance of universities in regional and

cluster development is becoming increasingly apparent, as is the increasing relevance of local regional development agencies as symbiotic partners to universities.

Most SME policies developed by policymakers across Europe are relatively conventional and do not take into account the interactive mechanisms that can foster learning processes. They maintain that there is a need for an interactive process generated by a bottom-up approach of competitive advantages based on localised knowledge and learning.

This calls for enhanced relations and networking at the level of firms – clients, institutional networking, subcontractors and suppliers, research and training institutes and so forth as well as networking between public and private actors such as producer associations.[4] Taken together, these actors can produce new innovation which is external to the firm, but internalise within a local system of firms. In other words, there is a need for "strategic innovation, planning innovation, to foster the internalization of externalized codified knowledge and the adaptation and development and diffusion of existing tacit knowledge" (Garfoli and Musyck, 2001).

Finally, in addition to these factors the availability of finance and VC are also key elements in aiding innovation development. Dynamic regional economies such as Silicon Valley and Route 128 in the USA, and Cambridge in England, are usually supported by a vast array of sources to fund early stage product and process development. In fact, these locations often have other sources of VC such as so-called business angel networks and investor clubs which also help to germinate the innovation process. In less well developed regions across the OECD, the public sector often has to try and bridge the funding gap through aid schemes for innovation in SME.

Given the complex factors underpinning RIC, there is no "silver bullet" that will enhance the innovative capacity of a region. Rather, a combination of the ingredients mentioned will need to be brought together to ensure that the environment is suitable for successful innovation development.

2.5 The importance of regional actors

It is no surprise to discover that there are many types of RIC given the elasticity of the concept (see Box 1.3). In order to better understand RIC, it is necessary to differentiate between different ideal types and to confront systems under study with these ideal types. Asheim (2004) distinguishes between three different

4 They cite the Norwegian TEFT programme as an example of non-conventional innovation policy-making. The TEFT programme aims to help SME in manufacturing and produce services to collaborate with the four largest polytechnic research institutions in Norway. The scheme is further enhanced by the action of county-based technology attachés whose task is to match the technological needs of firms with the technological potential of the institutions.

types of innovation systems: territorially embedded regional innovation network, regional networked innovation systems and regionalised national systems of innovation.

Territorially embedded regional innovation networks base their innovation activity mainly on localised learning processes stimulated by geographical, social and cultural proximity. Examples of these are to be found in the classical 'Third Italy', where public intervention is nominal (for examples in this regard see Evangelista *et al*, 2002). Regionally networked innovation systems are seen as the ideal type of RIS. These regions have strongly embedded local interactions, which are supported by so-called thick institutional supporting environments, especially R&D institutes and vocational training bodies.

This model is often found in Scandinavia and Austria where social partnerships are strong and government intervention is welcomed. The regionalised national innovation systems are based on an exogenous development model that aims to attract innovation into the region through a traditional linear knowledge flow. Technopoles and science parks are commonplace in this model.

Although this helps us to categorise regional systems of innovation, it lacks analytical power in some respects. This weakness is augmented by the lack of data availability. Most of the work on RIC involves secondary analysis of official governmental data. At the subnational level, data availability on firms and the various actors shaping RIC is sparse. There has also been insufficient empirical research involving primary data collection of firms within these systems, although this might vary from one country to another.

Box 1.3: The Regional Innovation System

The concept of a Regional Innovation System (RIS) was introduced in economic theory during the early 1990s. It describes "a concentration of interdependent firms within the same or adjacent industrial sectors in a small geographic area" (Isaksen and Hauge, 2002). This systemic approach to innovation recognises that innovation stems from interactions within a network of different actors, including firms and institutions. It is seldom the result of efforts within a single firm. While national systems of innovation are invoked to explain differences in innovation performances between countries, regions are increasingly recognised as the cradle of innovator networks, local clusters and cross-fertilising effects of research institutions (Lundvall and Borras, 1997). An RIS can stretch across several sectors and clusters, as long as their constituent firms interact. At the same time clusters can develop close links with knowledge organisations outside the RIS.

Source: OECD, 2004.

2.6 Regional divergence

Despite these caveats, some important results can be drawn from available national and regional data analysis. Statistics tells us that some regions are clearly doing better than others and that disparities between regions seem to persist while they have diminished between countries. This is particularly the case for the EU and many studies have identified innovation and knowledge as the major explanatory factors.

There is, of course, a broad range of other potential contributory factors, such as specialisation and sectoral structure, infrastructure and strategy as well as governance. However, empirical work has shown significant positive correlation between R&D expenditures and GDP per capita, with a convincing general relationship between GDP per capita and the number of patent applications per million inhabitants according to an OECD exercise using calculations for 180 EU regions at territorial level 2.

Differences between regions are particularly pronounced in Europe in both R&D and patents. Differences are also notable in the USA, where 50% of total R&D is concentrated in six states with a major share of patent applications. These findings emphasise the importance of agglomeration effects for knowledge creation and diffusion. The results are in line with a similar study done for the EU Commission by Prof. Hilpert back in the 1990s, which pinpointed the Archipelago Europe as a small number of "islands".

These islands were relatively small in size with a high concentration of research laboratories, both from firms and public bodies such as universities, working together intensively as a very exclusive cooperative networks of "islanders". This left laboratories and enterprises from regions outside these major islands with very few cooperation opportunities (5% of all cooperation partners in Europe were located in peripheral regions). The ten major European islands were home to 80% of all research laboratories and firms that participated in transnational R&D cooperation networks in Europe. One of the key findings of the study was the positive relationship between the quality of cooperative links and the peripherality of the region. This unbalanced situation has not encountered dramatic changes recently.

In the field of innovation, international ranking exercises are often biased towards R&D based innovation. The European Innovation Scoreboard (EIS) provides good coverage for categories such as human resources, knowledge creation, transmission and application of knowledge, as well as innovation output. It works well for identifying strong R&D regions, but less so for highlighting future potential in regions or regions with diffusion capacities. In the mid-2000s more new knowledge and innovation parameters were incorporated than ever before.

The EIS result confirms the strength of capital regions and the concentration of R&D and knowledge capabilities in a limited number of urban regions[5] (only one-third above the average), with a critical mass of skills and where the best universities can be found. According to the Regional Summary Innovation Index (RSII) the leaders are Stockholm, South Sweden, Uusimaa (Finland), Oberbayern, Stuttgart and North Brabant. For the first three, it is due to their well-educated workforce and for the subsequent three, it is due to their good patent performances.

2.7 Soft parameters

Regional benchmarking must take into account the multifaceted and heterogeneous nature of the innovation process. The theory of RIC draws heavily upon the role of collective learning, which in turn refers to deep cooperative relationships between members across the entire system. Innovation is rarely the result of a firm operating in isolation. It is more often the outcome of a joint effort amongst firms, technological intermediaries, research institutions, universities and other HEIs. What is required is to assess the performance of the regional innovation system (RIS), i.e. of a certain regional configuration (certain authors consider the RIS as the ideal, but this is not our assumption here). This assessment does not only depend on infrastructure, such as R&D investments, skill levels, number of researchers, number of innovative firms (the stock), but also on the intensity and quality of the knowledge shared between actors (the flows). Soft parameters that allow for the exchange or "transmission/reception" of knowledge for new products and processes facilitate innovation and enhance the capacity of the RIS to percolate. Three of the most important soft parameters are the absorptive capacities of firm, creative capital and social capital.

2.7.1 The absorptive capacities of firms and notably small and medium-sized enterprises

These capacities are critical for firms to have access to the necessary information, enabling them to act as intelligent customers and to monitor emerging technological areas. In addition, the successful introduction of new innovations often requires firms to change their organisational structure and work practices. Local development bodies are best positioned to support firms in these areas as they can work intensively on an ongoing basis (without being

5 According to the World Knowledge Competitiveness Index, compiled by Robert Huggins Associates, forty-nine of the ninety top metropolitan regions are in the USA. Calculations indicate the following ranking: Minneapolis-St Paul – USA (1), San Francisco – USA (2), Austin – USA (3), Denver – USA (4), Washington – USA (5), Raleigh/Durham – USA (6), Dallas – USA (7), Boston – USA (8), Stockholm –Sweden (22), Uusimaa – Finland (36), Ontario – Canada (48), London – UK (50). The index is based on four key variables: human capital, knowledge capital, regional economic output and knowledge sustainability.

in competition). Local development agencies tend to have better contacts and linkages with SME, whereas larger firms are supported through national R&D schemes and programmes.

2.7.2 Creative capital

This is embodied in entrepreneurs, artists, scientists and other self-motivated people that have a strong impact on the economy through their ideas and commitment to achieve their projects. Indices have been calculated in Florida on the basis of three Ts: Talent, Technology and Tolerance. While the concept is interesting, the measurement is relatively conventional with emphasis on the share of high-tech sector in the economy, patent application intensity, the share of the population employed in creative occupations and social creativity. The USA clearly leads for the creative class (30% of the population) and technology.

2.7.3 Social capital

Social capital is related to society and social life, network norms and the trust between partners allowing them to interact more efficiently to reach common goals. Social capital provides a relational infrastructure for collective actions, facilitates cooperation and enlarges the capacity for networking to lead to mutual benefits. This is critical to knowledge creation, diffusion and transfer. These parameters are particularly critical for small business and related issues need to be addressed. In many regions, particularly in the less developed ones, especially in Europe, SME are the Achilles' heel of innovation performances, despite their important potential for introducing new products and processes on the market.

3. Regional policies themes and targets

Regional development policies are addressing an increasingly broad range of themes and targets whether at national, subnational or, in the case of the EU, supra national levels. With respect to innovation related initiatives, it is possible to categorise them into six broad groups.

3.1 Strategic planning foresight and technology visioning for regions

Foresight[6] is an approach to strategic thinking and policy-planning in the field of science and technology that has become increasingly important over the past decade. It is applied to a set of participatory practices or techniques which

6 Foresight can be defined as the application of systematic, participatory, future-intelligence-gathering and medium-to-long term vision-building processes to informing present-day decisions and mobilising joint actions.

are used mainly at national level, but also at regional level to analyse future challenges from a multi-disciplinary perspective and to identify policy options and strategies (Gavigan & Scapolo, 2002). The key features of foresight are summarised as follows:

a. The emergence of foresight as a new way of informing policy and strategy development is an inevitable response to the increasing difficulty of making appropriate and robust decisions in the midst of rising uncertainty.

b. The philosophy and methods of foresight are needed for decision making and planning at all territorial levels, in both public and private sectors alike.

c. As the nation state of governance still predominates, it is not surprising that foresight first flourished at this level. But as foresight has begun to move upwards to supra national levels and downwards to subnational levels, there is a need each time to make crucial adaptations in terms of the instruments, methodology and issues focus.

d. National foresight cannot satisfy both national and regional requirements at the same time. National foresight can, however, feed into regional foresight as one of many other external input and vice versa.

The relevance of foresight at the regional level, especially in less-favoured regions, is the ability of the approach to support the design and implementation of long-term, realistic and locally supported innovation paths. As noted in previous sections, a dynamic regional innovation system is associated with the effective utilisation of knowledge (especially tacit knowledge) and learning processes in a social and institutional context of interaction and cooperation among regional and local actors. It is argued that regional foresight can help to build a common idea for the future of a community through concerted planning which is long-term and multidisciplinary, focusing more on the process than on the result, i.e. as a collective learning process and involving an iterative approach which leads to objectives or scenarios.

Research suggests that foresight approaches are well suited for integrating different foci in one process. Miles *et al* (2002) find that most regional foresight exercises are not exclusively focused on science and technology, but combine technological developments with social issues such as demography, identity, networks and human capital. It also combines sector development such as enterprise clusters and SME, as well as a territorial vision.

As such objectives may vary greatly, encompassing the promotion of competitiveness and economic growth, but also development of change capacity, network building and policy learning. Participation may be limited to the science and technology community as in Lombardy, Italy, or the business sector in West Midlands, UK, but equally may include a much wider range of relevant stakeholders as in Lyon, France. The time horizon over which

foresight planning takes place may be as little as 3–5 years with reference to West Midlands, UK, or up to 20 years as in Limousin, France. Crucially, it is a process that may be more than a once-off planning exercise and can embed institutional monitoring evaluation and learning capabilities.

3.1.1 Main issues

Foresight at subnational level is, however, still in its early days and notwithstanding its application in some regions and future potential, there is a need for clearer understanding of its role, mechanics and value added. Three groups of problems have been identified:

a. There are conceptual challenges with respect to the distinction between foresight and other planning tools, the legitimacy of foresight results versus other democratic decision-making processes, and the integration of input by civil society.

b. There are methodological problems relating to the selection of methods for different purposes, such as limitation of tools and validity of interactive methods. There are also the issues of amalgamating diverse input into a coherent message and the lack of adequate benchmarking and evaluation methods.

c. Procedural difficulties can arise from the lack of motivation among participants, lack of support and funds, continuity of the process after the initial project is completed and the transferability of successful case studies to other cultural contexts or regions.

3.2 Regional and local infrastructure: Science and technology parks

Among the longest established policy instruments for promoting regional R&D and innovation is the creation of high-tech industrial spaces, which are intended to provide a supportive business environment for innovative firms. The aim of these spaces can be determined as "an attempt to increase technological creation by minimising transaction costs associated with the collaboration of economic bodies previously hindered by institutionalised constraints" (OECD, 1999). The rationale is that physical proximity between specialised firms and between enterprises and other technological organisations, combined with appropriate organisational arrangements to facilitate cross-fertilisation, will lead to better exploitation of technological creativity.

At its most basic, a technology park may be little more than a traditional type of industrial estate, but providing modern premises to attract technology-based firms and jobs. In the context of a university location or public research laboratory, a science park would typically be seeking to promote commercial

spin-offs from publicly funded research, supported by incubators which can nurture new technology-based firms without full exposure to market economic conditions for a limited period of time. At their most sophisticated, such initiatives seek to bring together high-tech enterprises, research institutes, financial and business services, supported with various technology transfer and knowledge dissemination mechanisms to maximise interaction.

Numerous sites have been established over the past thirty years in a variety of forms, encompassing (without common definition) technology parks, science parks and technopoles. Small regional science parks and incubator centres generally emphasise a seedbed function, characterised by high rates of entrepreneurial activity and high-tech start-ups. The assumption is that the rate of growth of such start-ups will exceed that for firms in locations without such privileged access to services and information. The fact that firms like Hewlett Packard and Apple grew up in science park locations certainly adds credence to the theory that co-location of this kind provides advantages to small firms.

Effective technopoles appear to share three main features:

a. Raw materials in the form of a research field, manufacturing or service companies, HE and finance and human resources.

b. A complex cross-fertilisation function, comprising organisation, communication and a technopolitan culture.

c. An added value element involving the creation of innovation, representing the emergence and use of new technological knowledge, the creation of new products and processes, the creation of durable and stable jobs, the arrival of new enterprises, the installation of new services, and the emergence of a beneficial image.

On this basis we can distinguish between two types of space:

a. Real technopoles: Including the market-led USA cases, the French technopolisation process and individual cases in the UK and Asia, which are more ambitious and encompass measures.

b. Quasi-technopoles: Denoting all the small technology parks, created with science-push and spin-off initiatives as well as virtual parks which try to assure cross-fertilisation with low cost and risk. Also, business information centres which, because of their proximity to a research organisation, favour the name rather than the content of a technopole or a science park.

3.2.1 Main problems and issues

The use of these two types of technopoles as an instrument of regional development has been much debated. Works by several economists seem to demonstrate that attempts to decentralise the high-tech complex and to

promote regional equality through the endeavours of science parks had mitigated results. In the case of the Japanese technopolis programme (1983–1998), many analysts expressed doubts about the strategy. It was said[7] that (OECD, 2002):

a. Only the less innovative parts could be transferred to peripheral areas.

b. The number of technovilles that a country could afford is more important than their location.

c. Competition between prefectures had been institutionalised, but new, independent and self-sustaining centres of innovation had not emerged.

d. Many of the technopoles were artificial recreations of Tokyo suburbs.

e. Since the central government did not make any substantial commitment, prefectures had to finance the bulk of the investment, thus limiting their revenue-raising capacities all the more as they gave tax breaks to attract investment.

The technopolis concept was nevertheless successful in encouraging widespread regional technological development and in stimulating prefectures to design and implement technology development programmes in collaboration with the central government. It was also suggested that, overall, the instrument succeeded in reducing disparities, but that there had been a strong and negative correlation between the success of the twenty-six sites and their distance from the Tokyo, Osaka and Nagoya metropolitan areas.

In general, technopolis policies have been criticised for resulting in costly investment mainly born by the public sector[8] and for siphoning off activities and firms, notably SME, from adjacent areas. Some experts argue that the level of R&D depends on the size of the firms in the park – the more important the share of new technology-based firms, the more R&D and impact on local growth. Recruitment policy by science parks could be crucial in this connection. Finally, the degree of interaction between universities and firms has often been overestimated, although it is now increasing in a number of parks. According to numerous studies, parks operated by universities seem to generate more growth than those operated by non-universities.

3.3 Collaboration measures: Cluster policies

While science parks or technopoles tend to start from the facilities that the site offers and use these features to attract firms, another approach is to target already co-located firms. Cluster policies encompass a range of activities to promote greater interaction among firms and other organisations within a

7 See in particular A. Markusen's seminal work on Japan.

8 For Sophia Antipolis, one of the most important technopole in France, the sunk cost is estimated to more than EUR 700 million.

geographically bounded concentration of industrial activity. Although there has been some questioning of the degree to which "cluster policy" is more than a reformulation of traditional sectoral policies, they are widely regarded as innovative in bringing together formerly separate policy elements.

Cluster policies have proliferated over the past decade, with manifestations ranging from policies to encourage low-resourced, small-group business networks without a particular sectoral focus to complex, large-scale programmes of coordinated measures that target a specific, geographically-cohesive industry. Measures tend to provide common resources for groups of inter-related firms – such as specialised infrastructure or specific skills training programmes – or to encourage linkages between and amongst firms and research providers. In this, cluster policy has been presented as a form of regional policy that affects the relationships between the "relational assets" rather than the assets themselves in a region. Benneworth *et al* (2003) consider that these policy measures can be subdivided into three groups: support for existing clusters, support for businesses that already collaborate, and establishing new collaborations between non-cooperating businesses.

With respect to specific measures, a survey of research on support for clusters in less-favoured regions identified a series of actions that have proven to be successful in one or more places (Rosenfeld, 2001):

a. Regional economic analysis and benchmarking to better understand how the regional economy functions as a system and which policy levers are likely to have the greatest impact.

   Actions: identification of clusters; modelling and mapping of systemic relationships; benchmarking of clusters against competitors.

b. Engagement with the collective needs of employers and institutions.

   Actions: recognition of unmet needs; creation of cluster associations; formalisation of communication channels; fostering of inter-firm collaboration.

c. Organisation and delivery of services around the complexities and interdependencies of business needs, rather than individual generic functions.

   Actions: organisation and dissemination of cluster-oriented information; establishment of one-stop cluster hubs; formation of cross-agency cluster teams; creation of cluster branches of government; facilitation of external connections.

d. Building a specialised workforce, with the aim of producing workers who are more productive, informed about labour markets and better connected to employers.

   Actions: qualification of people for employment; use of clusters as context for learning establishment of cluster skill centres; formation of partnerships between educational institutions and clusters; support for regional skills

alliances; working with non-governmental organisations to reach low-income populations.

e. Allocation and attraction of resources and investment to maximise impact on the economy.

   Actions: incentives or purpose-specific funds for multi-firm projects only; investment in cluster R&D; support for applications for national and EU funding in less-favoured regions; funding of critical foundation factors such as education, healthcare and housing.

f. Stimulation of innovation and entrepreneurship to generate new ideas and new enterprises.

   Actions: investment in innovation and business start-ups; support for cluster-based incubators; facilitation of entrepreneurs' support networks; promotion of innovation networks; building of technology cluster hubs.

g. Marketing and branding of the region.

   Actions: targeting of inward investment; promotion of clusters; formation of export networks; exploiting opportunities for regional branding.

These services can be provided by a variety of different actors, each having certain advantages. Legitimacy in building consensus may favour governmental agencies or associations. The same can happen when services imply disclosure of sensitive information or broker between potentially conflicting interests. Thus public or collective actors may be perceived as offering better guarantees of neutrality and confidentiality. Other factors may work in the direction of private or quasi-governmental actors and the first among them is the need for specialised skills. Furthermore, the level of accumulated learning in servicing companies may be a crucial problem, especially for those actors that are newcomers in this field.

In order to capture the benefits of clustering and help firms specialise, policies should in theory encourage inter-firm relations, technological spillovers from private and public laboratories, and promote producer services. Through targeted, collective measures, instead of direct aids to individual firms, policies can promote investment in both physical and the soft infrastructures which refer to networking, fora for exchange and cluster animation that build local social capital. Support for non-R&D based innovation should not be overlooked, given that a large majority of clusters are not highly tech-based.

Among the examples of cluster policies operated by OECD member states, Austria has been a pioneer of the cluster concept in regional development, particularly in the *Länder* (state) of Styria and Upper Austria. In Finland, the Ministry of Interior has run three successive rounds of the Centre of Expertise Programme, which provides matching national funding for designated regional centres to encourage networking in specialised industrial fields.

Dutch cluster policy has been designed to address four specific market failures: a) limited interaction; b) imperfect information; c) weak demand; and d) poor knowledge infrastructure coordination.

3.3.1 Other common issues confronting clusters

The need for reinvention around their core strength

In many sectors clusters need to strengthen their comparative advantages in the face of growing competition – in particular from developing countries. This also applies to high-tech segments of markets which are no more immune to this competition than in the past. Because of these pressures, clusters and networks need to take maximum advantages from cooperation links and synergies for innovation. They will be successful if they are able to specialise in high value-added niches and redeploy their production lines internationally. Silicon Valley was and still is an emblematic example, especially after the high-tech bubble.

The need to extend the geographical area to functional regions

As underlined by Porter in a number of USA cases such as Research Triangle Park[9], San Diego's "innovation economy", and others, the success of the decentralised approach to clusters have often reached their limits, in particular because they have been conceived in a narrow area. Overconcentration of activities, transport problems, increasing cost of housing, and declining quality of amenities are constraining cluster development. A good way to overcome these obstacles would be to reconsider the strategy and to design it over a territory that goes beyond the metropolitan area borders and integrate the neighbouring rural regions.

The need to develop cross-cluster approaches

Stretching the geographical area of the cluster is often required to struggle against lock-in and increase opportunities for innovation and growth. Innovation often emerges at the boundary of interrelated clusters. As shown by several OECD territorial reviews, trans-regional or trans-border strategies pave the way for a new wave of development in those regions. This is often due to the coalescence of streams of innovation originating in different and complementary activities. In the case of Oresund, cultural industries appear as one of the most promising opportunities for the further development of networking activities. This is not only due to the strength of Copenhagen as a major culture centre, but also to the less well-known, but effective quality production of Malmö in dynamic music, theatre and drama production.

9 The North Carolina Research Triangle has been built mainly around three counties, all endowed with a strong university, which engaged in the early 1990s in the branding of their territories. Under the auspices of the state, the partnership was extended to six surrounding counties in 1994, but this association left aside a significant part of the state and notably neighbouring rural areas.

The building of ties between the multimedia, communications and wireless technologies and the creation of a related supercluster lead to entirely new products and means of distribution.

3.4 Cooperation between firm and public research

Firms can cooperate not only with other firms, but also with other partners such as public research institutions. Some studies show that firms which cooperate with different types of institutions are more innovative than those who do not. Technological and business trends, especially shortening product life cycles, are encouraging these new approaches to innovation. Businesses now expect a reduced period between research and new product development, often with an increasingly diverse range of technologies. Coupled with the need to achieve maximum value for money, this is one of the main reasons that firms often look to external sources of technology and innovation, particularly with universities and research centres.

In this context, industry-university collaboration has expanded over the last two decades in most countries. In the USA university-based patents more than doubled during the 1990s. They now continue to increase, but at a slower pace after a decline in the early 2000s (Leydesdorff, 2013). University patenting at the United States Patent and Trademark Office (USPTO) grew exponentially during the 1990s and declined moderately after 1999. Since 2008 the trend is again upwards and the progression linear. The proportion of R&D in HE that was financed by industry has also increased notably in every G7 country during the last three decades. Furthermore, public R&D funding is growing to a much lesser extent than private funding, giving rise to new relationships between funding sources and research institutions. Industry benefits from access to the research output and universities gain from additional income. Occasionally, universities can receive revenues from patenting new innovations.[10]

There are several direct and indirect ways to efficiently induce cooperation between HEIs, businesses and subnational governments. Initiating long-term cooperation between universities and local and regional authorities, and granting seats to university representatives in local and regional bodies, contribute to HEI involvement in local governance. It could be instrumental in setting up fora to strengthen the dialogue and launch projects in order to develop certain areas of business or science. Such bodies for cooperation like, the Centre of Expertise in Finland or scientific platforms in Oresund with Denmark and Sweden, are numerous in Nordic countries. In the USA, a number of universities have established departments in charge of Industrial Liaison

10 These revenues are nevertheless limited. In the USA where the most competitive universities are found, HE technology transfer revenues have remained relatively modest during the last decade. It did not exceed 3% of the total university budget even in prestigious universities such as Stanford, Yale or Harvard.

Programmes (ILP). One of the most well-known is the Massachusetts Institute of Technology (MIT) programme. Specific frameworks such as science parks are furthermore a means for HEIs to sell their work and promote entrepreneurship among their researchers.

In many regions, industry/university cooperation is underdeveloped. There is no guarantee that research produced in universities will automatically flow to or benefit local industry. In recognition of this, many EU and other OECD countries have undertaken new policies to create "bridging mechanisms" between industry and academia. A common feature of these policies has been the establishment of technology transfer institutions often linked to local universities and research centres. Many of these policy proposals aim to increase knowledge, innovation and competency across a spectrum of local actors by building bridges between academia and business.

However, in OECD countries much remains to be done to fully tap the cooperation potential between the private sector and public research. Two difficult issues need to be addressed:

a. The weak capability of public research entities to market their research findings. Universities and public research centres often lack the ability to publicise their research. They also lack trained people and expertise for selling research findings. This in general does not apply to the USA, where universities have significant research budgets and contracts from firms, and where the scientific community is accustomed to dealing with the business sector.

b. Insufficient demand, mainly by small business, for university research. Small firms are often reluctant to engage in joint activity with universities, either because they are unable to precisely formalise their demand for research services and expertise or because they lack information about the supply of university research findings and consider it too basic and inadequate.

Small business expectations and technological demand differ significantly from those of large firms. They are nevertheless increasingly pressed to adopt cutting edge technologies when they are part of a supply chain and linked with large customers. Technology intermediaries or technological clinics within government agencies such as in Finland can help build a bridge with knowledge institutions. These clinics provide brokerage services and put firms in contact with university experts who may be able to provide them with solutions to their problems.

3.5 Further education oriented measures: Technical colleges

It is often easier for small business to dialogue or partner with non-university education institutions, namely technical colleges, especially in peripheral and

less-favoured regions where their role as a support to business is critical. These organisations are variously called community colleges in Canada and the USA, technical colleges in Denmark and the UK, further education colleges also in the UK, technical and further education institutions in Australia, polytechnics or *Fachhochschulen* in Austria, Belgium, Germany, the Netherlands and New Zealand, and also institutes of technology in Finland and Ireland. They have a role as upper secondary or tertiary education in common, targeting occupations such as technicians and engineers as well as having a strong regional or local focus in their operations.

The importance of technical colleges for innovation is twofold. Firstly, research has shown the significance of human resources as a determinant of the development process. Technical colleges contribute to the development of human capital via their education and training programmes, which upgrade the skills and technical proficiency of the regional workforce. Secondly, technical colleges have a role in helping SME to adopt new technologies and become integrated in regional production systems, tasks which universities are conventionally ill-equipped to undertake by virtue of their preoccupation with academic research and their natural linkages with larger or new technology based firms. In more rural and remote regions, these colleges may be one of the few support agencies available to SME.

However, the degree to which technical colleges are able to contribute to regional innovation depends on several factors such as their regional focus and commitment to economic development, accessibility to SME, flexibility of organisational structures, and associative behaviour (i.e. formation of strategic alliances) in relation to different organisations in the region (Rosenfeld, 1998).

4. Governance for industrial and innovation development

Policy targets are one aspect of policy-making. Another important issue is the level of government that needs to be involved in the design and funding of these policy packages. According to Porter (2003), nearly all the important economic factors shaping regional innovative performance rest at the regional level. For this reason he calls for regional policy-makers to be handed greater levels of autonomy in shaping and developing regional innovation and competitiveness. Clearly different countries have different types of regional autonomy and governance, therefore the levels of economic policy-making at the regional level vary accordingly.

There seems to be three types of science and innovation policy-making. First, in centralised countries, such as the USA, France, the UK and many parts of Asia, innovation policies are often implemented in a top-down fashion. In this model, innovation policies are devised by national governments and are either operated at the level of the nation state or are implemented by regional and local actors

on their behalf. A good example of this would be the Faraday Partnerships in the UK or the Regional Technology and Transfer Centres (CRITTS) in France. The emergence of a more regionally-driven innovation system is occurring in countries categorised in the top-down model such as the UK. Some analysts, however, detect that centralising forces remain strong and that current science and technology policy often works to the detriment of peripheral regions.

In these countries, many localised efforts designed to promote regional innovation have often taken traditional infrastructure-led approaches. Science parks, in particular, have often been viewed as a universal panacea for promoting technology transfer and research commercialisation, especially in areas where research-intensive institutions are located (e.g. Cambridge). They are now ubiquitous. A survey conducted in the UK discovered that around half of all UK universities had incubator facilities and science parks.

Secondly, policy-making in federal countries is much more locally driven and local innovation policies are generated in a more bottom-up fashion which often involves a close partnership of local actors working together in networks. In these countries, regional actors play a central role in creating the institutional thickness of the regional innovation system in areas such as vocational training institutes, research centres and certification bodies (Cooke and Morgan, 1991). This type of approach is common in Germany and Austria. Even national industrial policy promotes regionalised solutions.

In order to promote networking and clustering in the biotechnology sector, the German government launched the BioRegio initiative. Launched in 1996, BioRegio requires regions to submit ideas for the development of bio-technology on a regional basis and awards financial and other special support to the selected regions. The main criterion for selection is the existence of collaboration between all the parties concerned, i.e. universities, industries and the public administration in the competing regions. In particular, the fund aims to promote the transfer of scientific knowledge in biotechnology from universities to German industry, thus speeding the commercialisation of biotechnology research into products and processes.

Thirdly, some countries appear to be somewhere in the middle of these two models. In this model, countries which were formerly driven by the top-down approach are now becoming more open to a bottom-up approach. Although these countries are still unitary, they are devolving an increasing amount of autonomy for regional policy to the subnational level. In terms of innovation, an increasing amount of discretion is required of local actors to shape the regional innovation system. Finland and Sweden are good examples of this emerging model. Both countries have embarked on major innovation and cluster development programmes. There is the Competence Centre programme in Sweden. Finland has the Centre of Expertise programme which represents the key policy initiative for promoting a "more regional oriented development"

(Asheim, 2004). The overall objective is to identify regional strengths and create economic growth by developing new products, services, enterprises and so forth.

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CHAPTER 2

SUPPORTING INNOVATORS, INNOVATION POLICY INSTRUMENTS AND PROGRAMMES[1]

1. Introduction

Innovators are entrepreneurs first and foremost, and they need marketing intelligence and basic support, as the product or process they seek to introduce is new. Yet, trying to link knowledge and creativity to the market requires skills they do not often possess. Their potential customers are increasingly demanding and both global and quality control are crucial, especially in less developed countries where competition among producers is often insufficient. These entrepreneurs will require good industrial organisations if they are to succeed in solving the development issues raised by the generation of new products. More generally, they need accurate information and the capacity to communicate innovation.

Innovation – new products and processes – are introduced in the marketplace because of dynamic entrepreneurs, the development of successful projects and efforts to respond to demand from consumers and manufacturing and service industries. They require market-relevant investment in R&D, creativity and often cooperation between HEIs and firms. Because outcomes of innovation are highly uncertain, firms and entrepreneurs are reluctant to invest sufficiently in R&D, and manifest risk-averting behaviour which often stifles creativity. In addition, lack of an enabling environment and the difficulty of appropriating the economic benefits of investment in innovation hamper the development of collaboration between firms, as well as between firms and research institutions.

Governments increasingly try to address these issues. Since innovation is recognised as a key catalyst for productivity and economic growth in the knowledge-based economies,[2] it's now often placed high on the policy-makers' agenda. In the last decade, science and technology policies have received additional momentum and are now focused on collaborative R&D in most OECD countries. Industrial and enterprise policies also seek to promote technology related clusters, them most notable of which are SME clusters. These different policies are combined through a focus on innovation systems.

1 This chapter relies on extracts from author Patrick Dubarle's work first published by the World Bank (2010: 73–105) in *Innovation Policy: A Guide for Developing Countries*. These extract were used with permission from the World Bank under the Creative Commons License, which permits published material to be adapted and built upon.

2 As economies become more knowledge-intensive the proportion of total growth in output (in the developed world) resulting from innovation is likely to grow (Simmie *et al*, 2002).

At a more practical level, the intensity of innovation in a country is influenced by the generation and diffusion of new technology and knowledge, the technology transfer effort made by government, and the success of the education system in producing science and engineering graduates. The absorptive capacity of firms is therefore crucial for innovative ideas to be translated into productivity gains. Proximity is the glue that helps to combine all these dimensions. This means that support to innovators is often the result of initiatives by local or regional governments. Since national policies can better embrace the more global aspect of the knowledge economy, innovation policies need to be aligned between the different levels of government.

The growing decentralisation of innovation policy goes hand in hand with the need to improve the efficiency of the support to innovators. Local authorities can be more selective when they target recipient firms. They have knowledge, better information about local firms with high potential, and can better assess the risks linked with local or regional innovation. This affects both federal and unitary countries. Innovation is also increasingly considered as a crucial driver of regional development. EU regional policy is gradually shifting its emphasis on new products and processes.

Central and subcentral governments have a great range of business assistance programmes and support to innovators on offer. They usual revolve around the provision of technical assistance, expertise and other real services, i.e. nonfinancial services in the area of marketing, logistics, technological development, exports, accounting, and so forth, mostly supplied by sector oriented and transfer of technology centres.

Since the demand for these services is originating mainly in small firms and new enterprises, support to innovators is increasingly a component of national or regional small business policies which aim at diversifying their supply and meeting the different needs of firms in relation to the different phases of the innovation process (i.e. design, development and diffusion). Given the cost of the development of new products and processes, and the risks encountered when commercialising new technologies, access to equity and VC is crucial. Government support is also taking new forms to echo the changes in innovation. Clusters and networks are becoming major actors. New policy approaches to intermediaries and bridging institutions are being designed and implemented.

2. Promoting the provision of real services

Real services involve supplying companies as payment with those goods and services they require. These services can be considered to a certain extent as (semi) public goods. They add to the endowment of the country or the region considered, induce learning and generate positive externalities. They are particularly important in low and medium income countries, because the

market is often unable to offer such service infrastructure due to low demand and asymmetries of information.

3. What are real services?

Real services include those service activities to manufacturing companies that are expected to increase the competitiveness and market opportunities, especially of user and innovative firms. The provision of these services transfers to the new knowledge of the user firm and triggers learning processes within them, thereby modifying their organisation of production and their relation with the market in a structural, nontransitory way. Real services are supposed to contribute to the speed and quality of economic development. "Real" in this sense is sometimes used as opposed to "financial". The idea behind this distinction is that small firms, and innovators in general, would be unable to identify the need for and retrieve the necessary information, even if financial assistance had been provided. This opposition is adopted here, although alternative positions suggest that financial services are also real to the extent that they impact on a company's structural variables. Another distinction suggests that non-real services provide the company either with basic, ordinary infrastructures (e.g. postal and standard financial services) or with alternative sources for peripheral activities that otherwise would be managed by the company itself. They may alleviate the costs for the company, but they do not change its strategic horizon.

In English language literature and policy documents other expressions are frequently found. They include industrial extension services or manufacturing extension services, support services, advisory services, business services, etc. Service centres, business advice centres, local enterprise agencies and small business development centres are among the most popular labels for the providers of this type of services. The distinction becomes even more complicated when trying to distinguish between technical advisory services and real services, the former including the provision of information, assistance and advice on technical matters only. For the purposes of the analysis the discussion in this section includes all types of "structural" services excluding financial support.

In OECD countries many key support or collective services are available in the market. However, such services may be publicly provided or public programmes may be financed privately. The common instruments to promote internal and external business linkages – including FDI and exports – often focus on the concrete needs of firms and access to foreign markets. Instruments include joint purchasing, partner search databases, using a common label, certification of standards, or the collection and dissemination of market and scientific intelligence (see Box 2.1).

Box 2.1: Different types of real services

The following services are suggested as potentially bearing a strategic relevance for innovation policy at the central or regional level.

a. Basic industrial services (promotion – marketing – internationalisation)
Assistance for tenders of the EU, World Bank and others; assistance to direct investment abroad; assistance to inward investors; legal and financial assistance; financial services-accounting, tax assistance; market information or other economic information; organisation of and participation to trade fairs and other promotion events; partner search.

b. Technology extension services
Assistance on patent and license matters; assistance to applications for grants; assistance to in-house R&D activities; assistance in subcontracting to research institutes; competitive intelligence refers to technological benchmarking; technology maps and information on emerging technologies; innovation diagnosis; review of current or proposed manufacturing methods and processes; participation in and organisation of technology exhibitions; technology brokerage; partner search.

c. Metrology, standard, testing and quality control
Calibration of equipment; quality certification; domestic standard adherence; International Organisation for Standardisation (ISO) compliance; technical assistance; centres and test factories; energy audits; materials engineering.

d. Innovation in organisation and management
Assistance to enterprise creation; interim management; logistical assistance; organisational consultancy, quality and training; productivity assistance; incubation services.

e. Information and communication
Advanced services for data and image transmission; assistance to communication strategies; assistance to telecom network connections; assistance to the implementation of electronic data interchange systems; database search.

Source: Dubarle, P. & Woyessa, Y, 2016.

In a number of cases private enterprises do not supply these services because there is an imperfection in the market mechanism. There is a number of reasons why the market does not produce the services required, such as that the expertise needed to supply the real services is often not to be found in the social environment in which firms operate.

The necessary investment to produce the services required is high and return on this investment may take a long time – there is a case of indivisibilities as well in this context. The private sector is ill-placed to provide the kind of real services that are demanded, because the very nature of the information involved here is a public asset (e.g. knowledge).

4. Pricing issues

At what price should the relevant agencies sell real services or include their support and how should an assessment be made as to the effectiveness of public money supplied to the agencies? The return on outlay can probably be evaluated by cost-benefit analysis. The costs involved include all public money earmarked for the agencies, plus the financial costs entailed in making private investments earlier than planned. The benefits to be gained are those resulting from the introduction of a set of new techniques into the production system. Productivity increases can be used as proxies, but scenario considerations should be introduced if accurate calculations are to be produced. Such scenarios should include vicious circles of decline in the absence of real services or virtuous circles of self-reinforcing attitudes. Thus, in the real world, the price is a combination of availability of public funds, propensities of firms to use real services offered, and political conviction for the role of real services in community income maximisation.

The agents, as suggested above, can be a plurality of different actors which include:

a. Governmental bodies or independent public agencies

b. Public-private partnerships and agencies: this mixed type is of special relevance for their ability to combine the advantages of legitimacy and neutrality of public bodies and, at least in theory, the efficiency and management styles of business

c. Consortia and specialised agencies sponsored by industrial associations

d. Private companies acting according to government guidelines or within government projects or subsidisation schemes

The performance of the different providers can depend on several factors (see Box 2.2). Some of them clearly relate to their institutional nature. The ability to, and legitimacy in, building consensus may favour governmental agencies or associations. The same can happen when services imply disclosure of sensitive information or honest brokerage between potentially conflicting interests: public actors may be perceived as offering better guarantees of neutrality and confidentiality.

Although the public nature of the provider may often be an essential feature, it must be fully and consistently accepted that a variety of providers can be instrumental to the realisation of effective real service policies. In any case, experience shows that the content of the service is more relevant than the nature of the provider.

Box 2.2 Conditions of success for service providers

The functions of real service providers identify a number of distinctive skills that need to be available to the provider's organisation (even when not within it):

a. **Awareness building** requires sophisticated industrial marketing skills.

b. **Problem framing** implies the ability to provide tailored diagnoses, based on a comprehensive and in-depth knowledge of company behaviour and organisation.

c. **Problem solving** implies the ability to carry out specific improvement projects based on distinguished technical expertise.

d. **Resource finding** (financial and non-financial) requires connections and expertise with institutional, public and private sources.

e. **Alliance building** implies the ability to identify and build innovative links between companies, and between companies and other actors, as well as the credibility necessary to guarantee the value and trustworthiness of the partners.

Source: Bellini, N. 1998.

5. Multipurpose infrastructure

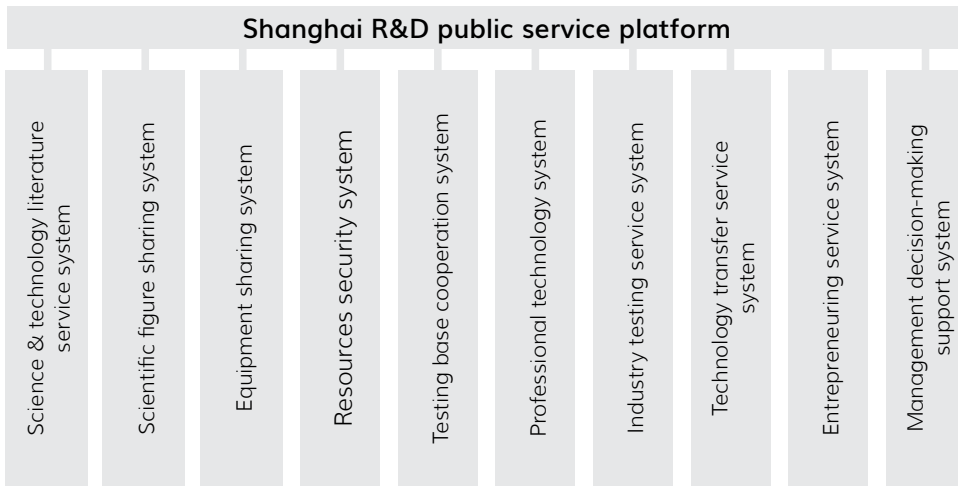
Variations in regional technology centres are related to the context of the regional and national innovation systems they serve. Such characteristics include the tradition in public-private partnerships, the availability of public support for industrial policy, and the skills of service providers. Different forms of service are also often required, as well as one-stop shops more practical for firms. Usually the more targeted the packages of services to the specific type of the firm, the more useful they are likely to be.

There are many examples of publicly (provided by government) or collectively (provided by industry association) multipurpose services in OECD countries. Nevertheless, in the USA and the UK, where there is a networking tradition such as industry and research associations, but constantly reducing subsidies, real service provision tends to become more market oriented and reduce riskier ventures. In Germany many technology centres form part of national research organisations like the Fraunhofer Society, and the development of science and technology policy is closely linked to these centres. The regional network of technical centres, called *centres techniques,* in France is funded through the payment of a specific tax, public aid and services revenue. In Italy real services are expected to increase the competitiveness and market opportunities of user firms by modifying in a structural way their production organisation and their relation with the market. They may include market information as well as testing and export support. These are often provided on a regional basis such as in Emilia Romagna. Spain is another country which has taken advantage of

this model for publicly provided multipurpose services in the form of technology and business development centres.

In emerging and less developed countries, the private supply of real services is generally not much developed, and for this reason the public sector in China takes the lead in trying to provide collective and supporting services that serve the innovation needs of firms and other local RIC actors. The lack of private providers of such services calls for an even greater public role in China than in OECD countries. As illustrated in Figure 2.1, the Shanghai R&D public service platform seeks to address a wide range of services similar in principal to what is found in OECD countries. These services cover the innovation development process from scientific information sharing, technology testing and transfer services to support in entrepreneurship and management. In Mexico, despite the fact that CONACYT (The Mexican Science and Technology Agency), public research centres remain institutionally under presidential authority. Their degree of autonomy concerning the orientation and organisation of their activities has increased recently. They have also been able to increase the share of self-financing in their total budget. This evolution led them to adopt a more market-oriented approach with a view to increase their cooperation with the private sector and other institutions to which they provide technological services.

Figure 2.1: Shanghai R&D service platform



Source: Shanghai Municipality Science and Technology Commission, 2006.

In Central and Eastern Europe the fragmentation of the public research arena, its limited market orientation, and low social capital point to the need for overhauling public research centres. The mechanisms to gear knowledge production towards commercial application and the absorption capacities of

knowledge users (i.e. small firms) are usually weak and reforms are ongoing. The branch R&D units are called *Jednostki Badawczo-Rozwojowe* (JBR) in Poland and have been under strong pressure to restructure. Though at the time of the communist era, these JBR collaborated closely with industry and were considered as a substitute for in-house R&D. They lost some of this role in the transition. Many JBR are now specialising in knowledge production and some have been privatised; their numbers have been reduced from 187 in 2004 to 130 in 2008. Nevertheless they remain important service providers and major actors in terms of links with business. In Hungary the supply of technological services has been reorganised on a territorial basis. The newly created regional innovation agencies (RIA) play an important role as intermediary organisations in this context. They complement existing institutions which have already been established since the early 1990s, such as the Innovation Relay Centres, created with the support of the R&D programmes of the EU.

6. Specialised service infrastructure

Services are being offered in the market, because there are various bottlenecks that act as barriers and threats to innovation. As featured in Box 2.1, bottlenecks created by shortages of expertise are of particular interest. Of concern here are various fields of innovation activities. First of all, innovators are primarily entrepreneurs and risky investors in an urgent need of market prospection intelligence and basic support, all the more as the product and processes they are introducing never existed before. Secondly, linking knowledge and creativity to the markets requires skills that are often partially available within firms, hence the need for technological services. Furthermore, as products are to be accepted by increasingly demanding and globalised customers, quality control is crucial – especially in less developed countries where the supply of specialised services and competition between producers are often insufficiently ensured. As a consequence good industrial organisation becomes critical if firms are to succeed in solving development issues raised by the generation of new products. Lastly, common to all these needs is the need for accurate information, as well as the capacity to communicate innovation.

6.1 Basic services

Support to innovation is not only linked to technological assistance, but often related to industrial development. Investment promotion agencies play a specific role in this context, because technology is embedded in physical investment.

Attracting appropriate FDI or enhancing domestic investment requires dedicated efforts in a wide range of activities including the identification of suitable inward investment prospects and the active servicing of the strategic needs for foreign invested firms once established in the country. Development

of skills, recruitment services, and the identification and upgrading of local suppliers are crucial not only to influence positively the investors' decisions, but also to enhance the synergetic effects with the local environment. For these reasons Investment Promotion Agencies (IPA) need to be in a position to ensure the cooperation of different entities in charge of strategic resources such as infrastructures, training and skills resources, and SME promotional bodies. Regional agencies must also be supervised at national level not only to reach a proper level of efficiency through regular audits and continuous monitoring processes, but also to avoid the duplication of efforts, costly incentives wars and cut-throat interagency competition.

Studies of successful agencies in both advanced and developing countries show that investment promotion programmes entail a vast number of activities, including establishing the policy context, the priorities and forms of interventions, building up a promotion campaign for potential investors, meeting the needs of interested investors, and building a strategy on past promotional activity and implementing it.

In general, OECD countries practice a highly sophisticated form of investment promotion designed to achieve strategic industrial or regional development objectives. Scottish Enterprise, the chief IPA in Scotland, coordinates initiatives to encourage entrepreneurship with efforts to attract and retain inward investment.[3] In the Piedmont region of Italy, one of the most advanced in the country, the Piedmont Agency for Investment, Export and Tourism is organised as a one-stop shop for companies investing in the region. It is also in charge of running a financial instrument (which is unique in Italy) and the regional investment contract, whose objective is to foster the internationalisation of the region through investment growth (OECD, 2009). Within this framework, research entities, science parks and innovative companies can apply for aid or specific grants.[4]

Many emerging countries have also established similar IPAs which often exhibit good performance records. The Board of Investigators, the agency responsible for attracting foreign inward investment in Thailand, has designed a strategy that builds upon the ability of the country to provide cost-effective local input and stimulates the competitiveness of domestic part manufacturers. The availability of a large pool of trainable labour, natural resources and government protection granted to fledging industries have also been instrumental in contributing to the increased inflow of FDI. At the same time different incentive rates between central and peripheral regions have helped to reduce the

3 Scottish Enterprise's budget amounted to approximately GBP 280 million in the fiscal year 2010/2011.

4 The regional investment contract is an instrument to guarantee the simplification of legislation and thus the precise timing for start-ups and the development of new investment projects in Piedmont. The offer addresses all types of companies that manage operations in the production of goods and services, R&D and innovation. It gives priority to the most highly innovative sectors such as new sources of energy.

pressure on capital and congested areas. In that favourable context, FDI has increased from less than 0.6% in the 1980s to an average 1.52% of GDP in the 1990s and early 2000s.

6.2 Technology extension services

Technology extension is concerned with creating small but profitable improvements by extending already established technology to smaller firms. While the design of technology extension organisation differs, all of them have relationships with small enterprises and with sources of technology. Technology extension programmes either provide resources that enable firms to identify needs and find appropriate technological solutions or engage in the actual identification and provisions of solutions by means of targeted assistance.

In the USA such technical assistance is often provided by universities on a local basis through application engineering programmes in which engineering staff work with clients at the client sites. Some of these university programmes are industry specific, while others are "teaching factories" to which clients travel to receive direct assistance. Manufacturing Extension Partnerships (MEP) is a network launched in 1988 and covering all states through 400 MEP offices offering both public and private industrial services, including university extension services. The intention of the MEP was to bring front edge technology to their clients, but in practice it focuses on bringing help to existing traditional technologies and management.

Funding for these partnerships is provided by state, federal and private funds. Firms receiving assistance pay a portion of the cost which could reach up to 40%. These contributions seem to suggest that public money is needed for the provision of this consulting service. Comparative studies have shown that MEP assistance increases the rate of growth and adoption of technology compared to the ones not receiving help from the MEP network.

In Japan about 170 technology upgrading centres, called *Kosehtsushi,* are providing support for small firms. Unlike extension services in the USA, they deliver only technological services. Other services, such as management or financial, are offered by other agencies. *Kosehtsushi* conducts research, have open laboratories for training, test and examine products for compliance and promote technology diffusion. Most of the services are free of charge for SME. Every year 900 000 tests are carried out and around 3 900 technological advisers are mobilised to meet the 500 000 problem-solving requests addressed by client firms. Most of their funding is provided by prefectures/districts and by local governments; private sector contribution is limited (6% of the total). Their strength is due to the stable relationship that is established between the staff and the clients and rests upon the fine knowledge SME demand of personnel.

The need for efficient extension services is also recognised in emerging countries. In Chile, a private corporation called SERCOTEC, which is a branch of the Chilean Economic Development Agency (CORFO), is charged with the promotion of micro and small enterprises. Central to its strategy to assist SME, is its website, online advice and services provided at no charge to 30 000 registered firms supporting the mainstream activities of the agency. SERCOTEC has partnered with many other institutions to give expert advice and diffuse information to the clients. The system is low-cost, easy to implement and requires little maintenance. CORFO also operates the Technical Assistance Funds (FAT), intended to integrate modern business management techniques and new commercialisation technology and strategies.

6.3 Standards and metrology

The globalisation of value chains, with a multitude of firms acting as interconnected suppliers, intermediaries and marketers, has been sustained by the parallel drive towards the standardisation of practices and procedures. Firm interactions along the value chain require conformity with agreed standard business practices in contracting, accounting, project management and the communication of product design and engineering information.

Standards would be meaningless in the absence of the ability to make precise measurement of the various attributes – chemical, electrical, physical etc. – of the produced outcomes at each stage along the value chain, using common modes of measurement across international boundaries, with assurance that measured magnitudes are precisely correct within agreed error tolerances. Metrology is thus the essential foundation underpinning standardisation processes. This foundation is maintained through a carefully linked hierarchy of metrology agencies: some autonomous and responsible only for metrology, others embedded in organisations having linked responsibilities (United Nations Industrial Development Organisation, 2002).

In the USA the National Institute of Standards and Technology (NIST) supplies a number of these services through its regional network. It provides access to technical and standard databases and performs excellence guidelines for USA subcontractors and manufacturers. Calibration services are offered as well, such as special tests and measurement assistance programmes to monitor parameters and ensure appropriate quality control. NIST also funds industrial and academic research in different ways. It offers grants to encourage work in precision measurement, fire research and materials science. NIST has a policy on traceability and provides answers to client requests (NIST, 2007).

In less developed countries metrology, standardisation and industrial quality systems are integrated to various degrees and their service performance often limited. In Brazil technical regulations are decentralised through different line ministries and regulators, similar to the model used in advanced countries.

The national agency, INMETRO (National Institute of Metrology, Quality and Technology), maintains an updated technical regulation database through its webpage and makes available regulations and government resolutions on products subjected to compulsory certification. Different certifying bodies for quality management systems operate independently in the country, thus making the issue controversial at times.

6.4 Productivity centres

These centres are broadly focused and geared more to industry development than to technological development per se. They work with firms to promote efficiency and productivity in manufacturing, often changing their focus according to the changing nature of the problems under study.

Initially, these centres are generally funded by government at central level and promote the awareness of the nation for the need to enhance productivity. Most of these campaigns focus on the positive relationship between employment and productivity growth to combat the fear that increased productivity displaces workers.

The Japan Productivity Centre founded as an organisation of labour, management and academia, merged in 1994 with the Socio-Economic Congress of Japan. The principles of the newly formed Japan Productivity Centre for Socio-Economic Development (JPC-SED) were productivity gains, increase employment as well as labour and management had to work together. Gains from productivity should also be shared by labour, management and the public.

Productivity centres can thus provide vital information and services to private firms. The Hong Kong Productivity Council (HKPC) provides information on international standards and quality. It provides training, consultancy and demonstration services to small firms at subsidised rates, serving over 4 000 firms each year. The HKPC acts as a major technology import, diffusion and development agent for all the main industrial sectors in the economy. It identifies relevant new technologies in the international market, builds up its own expertise in those technologies and then introduces them to local firms.

National productivity centres provide a general agenda to regional productivity centres. These regional centres provide productivity assistance to firms. They directly consult and advise firms on management strategies, efficient floor layouts, labour and management relations and environmental concerns, among others.

6.5 Information and communication services

Providing information services requires information specialists who are also technically competent. These services are the least dependent on prior targeting

and the like. It serves as an intelligent gateway to globally available, searchable knowledge-based, intelligent-by-virtue trained staff-information services and offers a truly generic service of equal potential use to all consumers. As such they are the closest among service organisations to providing a public, universal value. However, many information centres also routinely produce materials to disseminate the results of the continuing search.

There are advantages in centralising these activities in organisations with special capabilities to carry them out. In France, officers from Regional Agencies for Scientific and Technological Information (ARIST) give advice on SME development projects given their technological and competitive environment. They assist firms in exploiting information associated with technological watch, regulatory regime, and standards and market, advising them on intellectual property and innovation business and warning them about counterfeiting risks. They also facilitate innovation workshops. These agencies are an offshoot of the National Association of the Chambers of Commerce and Industry.

Information website services have been developed in most development agencies all over the world. In Singapore, service portals serve as a platform for information exchange between "technopreneurs" (technology entrepreneurs) and investors. On the one hand, technopreneurs can obtain information regarding networks with business angels, VC, investment bankers, business consultants and other relevant agents. On the other hand, aspiring technopreneurs can also put up their business plans on the website where investors can easily access this information. These portals even go as far as to provide a complete guide on the various support services available to high-tech start-ups. Sufficiently publicised, Singapore's technopreneurship portals contributed significantly in overcoming information deficiencies that tend to deter start-ups.

7. Focusing on entrepreneurship and new innovating firms

Analysing support according to beneficiaries and segmenting targets is another way to look at public support to innovators. In fact, to a large extent targets determine government policy actions. In theory all firms are concerned with innovation, but in practice policies tend to be focused on particular categories of firms or find it the easiest to target particular firms. Assistance to large firms stimulates their commitment to precompetitive research and facilitates their involvement in large scale R&D projects, but big business operations do not require direct support that might conversely distort market competition. This is not the case for small and new firms that are at a disadvantage in their daily operations, because of their size and their problems of access to input markets.

While governments have in the past tended to underestimate the role of SME in innovation, they have rebalanced their priorities in the last decade and significantly increased dedicated schemes of small firms and initiated

preferential benefits in their programmes. This shift of emphasis can be explained by the following factors:

a. Innovations increasingly take place in small new companies. OECD research in three major global industries, notably ICT, automotive and pharmaceuticals, showed clearly that the role of SME has not diminished in major global industries. SME are often the prime source of new ideas that are integrated into other products or brought to marketing in their own right by large firms.[5]

b. The potential for developing new products and processes in small business is not well tapped. Although SME take an important part in the national economy – notably in terms of employment – they have limitations in accessing technological expertise, mobilising large scale resources and are generally slow to adopt new technology. This has consequent negative effects on their potential for growth and, in many cases, even survival. Small enterprise managers are often not aware of new technology, do not recognise the potential for improvements or lack the financial, organisational and managerial capabilities to incorporate new technology or to obtain external advice through consultants. Given that, for these consultants and technology providers the costs of reaching small firms with relevant information are relatively high, as are the costs of tailoring equipment to their needs, it is clear that technology markets suffer from problems of information asymmetry, transaction costs and a lack of scale economies and this warrants policy intervention.

What governments try to achieve in this field is twofold, first of all to better link entrepreneurs with knowledge – this means not only improving the infrastructure (the supply side) for technological services, but also to provide incentives for research (notably for high-tech-based SME), and more favourable tax regime and R&D grants (the demand side). Another aim is to adapt the assistance to the different phase of the lifecycle of new products and processes from design to maturation and internationalisation. Furthermore, they also try to provide a framework and incubate new firms on a local basis.

5 There are diverse reasons for this: a. Many of the most important innovations in manufacturing are adapted from other sectors outside the main competences of the manufacturers in that sector like the increasing importance of computer software in cars. In some cases this demand for expertise is met by large companies, but it is also an opportunity for SME who can often be more agile in adapting existing technologies. b. Large firms in R&D intensive industries are seeing the productivity of their in-house research decline and are looking for ways to improve output and share risks, such as by cost sharing with SME instead of having to internalise product development. c. Small firms are often more aware of niches or emerging markets: finding solutions to new legal or regulatory requirements.

7.1 Diversified policy initiatives to support small innovative firms

To respond to these challenges, government is setting up initiatives to increase the reservoir of new firms and stimulate entrepreneurship, high-growth SME and small firms in specific sectors. Forming new business and in particular high-tech-based firms are increasingly seen as a primary contributor to the revitalisation and expansion of the local and regional economic fabric and to the diversification of services.

In certain cases, starts-up are the result of public research. Since the 1980s the number of spin-offs from the HE sector has risen steadily in many OECD member countries.[6] These spin-offs are particularly concentrated in a small number of high-tech sectors, mainly IT, biotechnology and electronics. A number of policy measures have been adopted to help unleash their development potential. In the UK a financing pool was established within the framework of the University Challenge Seed Fund to help universities assist spin-offs. A number of universities has taken specific programmes on their own. In the Netherlands, the Temporary Entrepreuneruship Positions (TOP) programme of the University of Twente[7] helps graduates, university staff and people from trade and business to start their own companies providing them with advice and loans (University of Twente, 2012).

Beyond the start-up phase, the support to innovators also takes into account other stages of the life cycle of new firms, including the globalisation stage. In most advanced countries, governments increasingly aim to provide the most comprehensive range of support to new firms from incorporation to internationalisation. In the UK the main goals for innovation policy are to support more start-up businesses and to ensure their survive. Through coaching, mentoring, free advice and guidance, the purpose is first to increase the level of new businesses by enabling those with an interest in starting to take the step to do so – particularly overcoming barriers faced by individuals from underrepresented groups and disadvantaged communities. The objective is also to subsequently ensure that UK businesses, especially productive, innovative,

6 Even if their number remains modest in absolute terms, a double digit number in most countries, around seventy in Canada and a few hundred in the USA, they reflect a change of attitude in public research and a shift of emphasis towards more patentable and more market oriented research.

7 Future entrepreneurs present their business plans to TOP coordinators. A TOP Committee evaluates the relevance of the plan and determines whether the business idea fits within TOP. After admission the TOP entrepreneurs receive support for one year under the form of office space and facilities, access to networks, a scientific and a business manager and an interest free loan (EUR 20 000) to be repaid in four years. About twenty people participate in the TOP programme at a time. Since 1984, some 370 individuals have received support and some 320 companies have been created, 75% of which are still on going. On average TOP companies grow with eight to nine employees and on a regional level they are responsible for some 150 new jobs annually.

R&D intensive businesses, are able to identify and exploit opportunities in overseas markets successfully. For part funding, eligible firms are SME who are either new to export or innovative and between one to five years old. Co-funding for certain export projects may be provided, as well as information, advice and limited part-funding.

Box 2.3: Innovation vouchers

The objective of innovation voucher initiatives is to improve the links between public knowledge providers and small businesses, and to create a cultural shift in the approach to innovation of the small business community in the long run.

Typically, innovation vouchers are small-scale grants worth around EUR 5 000, which have to be invested in the acquisition of knowledge and/or consultancy from a regional research institute or a regional university. The main objective of such initiatives is to help overcome the traditional differences in mentality between the universities and the SME sector that prevail in many regions. Many SME tend to subscribe to a general perception that public research is too abstract and unsuitable for their needs. Consequently, they are very hesitant to invest in a collaboration of such kind. The idea of the innovation voucher programme is to enable first encounters on a concrete basis, but at no extra cost. Together with promotion campaigns, it is hoped that regional firms can be convinced to give such collaboration a try if they are associated with no or little additional risk.

Innovation voucher initiatives have been initiated in the Netherlands, Germany, France, the UK, Ireland, Spain, Italy and the Czech Republic, in many cases based on EU Structural Funding.

In general, innovation vouchers have been found to develop a relevant facilitating effect in regions in which the general propensity to cooperate is already high. However, their major weakness is that they are of no use if the perception of the local SME is actually right. From that perspective, the measure must be assessed critically in regions in which the strategic orientation of research institutes is not yet focused on applied issues. Moreover, it will not be able to achieve any effects in regions where the business models within the SME sector do not tend to be innovation-oriented. Although a number of innovation vouchers could be assigned even in peripheral convergence regions in the EU, they have not achieved a transformative effect on the overall nature of the relations between public research and the private SME sector.

Source: JIC, 2009.

Among the most recent policy initiatives in advanced countries, the following best practices could be mentioned. In the UK, the Small Business Research Initiative (SBRI) aims to raise productivity and business innovation by providing R&D contract to technologically-based small business, thereby helping to ensure early revenues and a route-to-market for firms that face barriers for their

early development. The government is also working to embed innovation in public sector procurement policy.[8] In the Netherlands most attention has been devoted to bridge the gap between SME use of knowledge and innovation and to grant special vouchers to small firms (see Box 2.3). In France, a scheme was launched in the mid-2000s to grant tax and social charges reductions for young, small innovative firms that were less than eight years old and devoted more than 15% of their total expenditures to R&D, provided that they were really new ventures (not the result of restructuring or the extension of pre-existing activities) and had an ownership structure which reflected its independence from other larger firms.

Needless to say, these concerns have also diffused into emerging countries. Since 1999 in China, grants are provided to small firms through the fund for small technology-based firms and beneficiaries are requested to match the grant amount. It is not the only programme addressed to SME, but the only one with an innovation focus. In Brazil, the federal government created a number of new programmes targeting the SME sector in the late 1990s with a view to help small business with technology transfer and innovation through loans and training. These initiatives were reinforced within the framework of the Innovation Act of 2004.

An integrated approach was also adopted in Malaysia to increase the capabilities for technology acquisition and global competitiveness of local SME. During the last decade several SME development plans emphasised the strengthening of advisory services, the creation of new ones and the fine-tuning of existing broad-based programmes. In Korea, technical and financial assistance for SME and new start-ups has recently been expanded by introducing new policies: accepting technology (knowledge asset as collateral for bank loans), providing SME with subsidies for the employment of R&D personnel, technical information and services.

7.2 Incubating firms

The most widely used instruments to support these various policy initiatives is the business incubator. Incubators refer to the practice of providing low-cost, property-based facilities and shared services to nurture the development of firms. Business incubators offer the use of shared premises, capital equipment, business and technological services on a temporary basis. The types of business support services typically provided in-house by incubator management include business planning, advice on accessing capital, marketing, the identification of suitable business partners and general strategic advice.

8 A pilot scheme – the grant for investigating an innovative idea – also continues to help SME in the UK to obtain practical advice when exploring their ideas for innovative products, services and processes (by covering 75% of the cost of outside experts).

Other types of business support services, such as specialist legal services, accounting and market research tend to be provided by specialist external providers with whom incubator management have established relationships.

Clearly, business incubator management, many as experienced former business people in their own right, have a critical role to play in supporting and nurturing early-stage businesses through the provision of high-quality business support services. Evidence from case studies and survey work suggests that business support services provided by incubator management can help bridge the traditional market failure in the provision of business support services to the small business market.

Many of the larger private sector business support organisations and management consultancies do not get involved in the SME market. Incubators involve a diverse set of sponsors and stakeholders, such as government agencies, universities, chambers of commerce and non-profit organisations. Private-for-profit agents also sponsor business incubators, generally as part of a real estate venture. Incubators allow convergence between innovation/ enterprise policy and real estate related initiatives where local authorities have significant control.

Incubators increasingly tend to specialise (see Box 2.4) in order to provide tailored responses to a wide variety of small innovative firms including those in specific sectors or clusters, microenterprises in a need of mentoring or tutorship, small firms with a narrow customer base, etc.

Box 2.4: Typology of incubators

a. General/mixed-use incubators
The main goal of these incubators is to promote continuous regional industrial and economic growth through general business development. While these incubators include knowledge-intensive firms, they also include low-tech firms in services and light manufacturing.

A main focus of support is access to local/regional sources of technical, managerial, marketing and financial resources.

b. Economic development incubators
These are business incubators whose main aim is to stimulate specific economic objectives such as job creation and industrial restructuring. The main goal is often, with the support of local government, to help create new firms and nurture existing firms that create jobs.

In some countries this goal may target specific groups such as the youth, the long-term unemployed, women and minorities. In the USA examples include empowerment/micro-enterprise incubators.

Box 2.4: Typology of incubators (Continued)

c. Technology incubators
These are incubators whose primary goal is to promote the development of technology-based firms. These are mainly located at or near universities and science and technology parks. They are characterised by institutionalised links to knowledge sources including universities, technology-transfer agencies, research centres, national laboratories and skilled R&D personnel. Specific industrial clusters and technologies may also be targeted, such as biotechnology, software, or information and communications technologies. A main aim is to promote technology transfer and diffusion while encouraging entrepreneurship among researchers and academics. In some countries technology incubators not only focus on new firms, but also help existing small technology-based companies to thrive.

Source: OECD, 2006a.

Support to incubators is often justified on the grounds of systemic market failures, i.e. because of the weaknesses of ties in the innovation systems, which can impede commercialisation and diffusion of technologies by new firms (see Box 2.5).

In addition, entrepreneurs face significant obstacles in starting businesses: high fixed and entry costs, lack of access to equity capital, insufficient technical and market information, as well as weak management skills. Incubator services can address most of these issues and help to reduce uncertainty, thereby increasing chances for survival.

When located in science parks, they can provide a significant contribution to local endogenous development while helping to stabilise job creation. It is also a means of enhancing returns of public R&D spending by promoting its commercialisation and diffusion.

Box 2.5: Good practices for business incubators

a. Maintenance of the building and the surrounding environment is crucial.

b. Delivery of high quality, reliable central services, such as telephone reception, mailing, conference and meeting facilities.

c. Technical support that may be either physical assistance or online support.

d. The workspace needs to be flexible to enable businesses to expand if they wish to do so, but also to accommodate businesses of different sizes.

e. Security for business is vital.

f. The terms of occupancy should be flexible, with easy entry and exit conditions.

Box 2.5: Good practices for business incubators (Continued)

Businesses learn from one another. As the learning curve is steep for young businesses, meeting opportunities should therefore be developed. Experience shows that social interaction can lead to greater trading opportunities. Workspace managers can facilitate this interaction.

A crucial managerial decision regards tenancy duration. Commercial workspaces will focus heavily on achieving high occupancy rates. Those funded from public sources may place more weight on moving tenants out after perhaps two years so as to free up space for new businesses seeking their first property. There is a clear trade-off between commercial returns and social objectives that has to be recognised by policymakers.

Tenant selection has to be undertaken to avoid clashes, or to focus the workspace on particular types of tenants, such as those in the technology sectors.

A critical consideration is the nature of business support to be provided to tenants. Some value this support highly, whereas others would prefer less support and a compensatingly lower rent. Normally this is resolved by not including support services in the rent.

Given the above considerations, it is not surprising that the most successful workspaces are public-private partnerships.

Source: OECD, 2006a.

In the UK and the Netherlands, business incubators were developed in the late 1970s and took the form of managed workplaces in which small firms were located in unused buildings and offered common services as a means of regenerating declining regions. In France, business incubators called *pépinières d'entreprises* provide temporary accommodation for individuals and small businesses and have mainly been sponsored by local government and community actors with the goal of stimulating local job creation. A main factor behind this has been the role of regional and local governments in developing incubators adapted to their specific economic and territorial needs.

In France, public support to incubation remains important to promote technological entrepreneurship. Over the period of 2007–2009 it was estimated that the central government, in partnership with the EU and regional and local authorities, provided EUR 21 million to support 761 projects in 31 public incubators.[9] While performing relatively well, they have so far nevertheless

9 So called *allegre* incubators (public incubators) have been established in France in the wake of the 1999 HE law to stimulate technology transfer from public laboratories to the market. Over the 2001–2013 period, 3 675 projects came to fruition within these incubators and generated about 2 500 spin-offs (34% in the ITC sector, 28% in the life science and 29.8% in the engineering sciences sectors). See Ministères de l'Enseignement Supérieur et de la Recherche (MER). 2014. Brochure Février, Paris. www.enseignementsup-recherche.gouv.fr/cid67043/les-incubateurs-publics.html

failed to attract significant private investment. In Italy, business incubators are a recent development and they generally target the creation of manufacturing and innovation firms in depressed industrial regions of the north and the Mezzogiorno (the southern regions of Italy).

In general, incubation support to new firms is provided by Business Innovation Centres (BIC) and some science parks, while the Citta Ricerche networks of innovation centres mainly provide services-based support to innovative SME. In Germany, incubation is a function largely carried out by innovation centres and technology parks.

According to the EU, empirical evidence shows that supporting incubators is a cost-effective way in which national and subnational authorities can facilitate the development of entrepreneurship. The impact of business incubation has been highly favourable, with 90% of firms inside incubators still active after three years. Furthermore, the 900 business incubators operating in Europe have assisted in creating 29 000 enterprises annually, a rate which is higher than those enterprises created outside of the incubation system.

In a number of emerging countries, in the wake of the creation of science parks and the renovation of science and technology policies, incubator creation has received new impulses. In China, the inclusion of innovation centres and incubators in the Torch programme have led to a considerable increase in the number of incubators (from 614 in 2007 to 1 034 in 2011).[10] They have been particularly effective as vehicles to link stakeholders and support firm spin-offs. The creation of 40 university science parks has also been an incentive for the establishment of incubators close to universities.

In the Gulf, the success of the Bahrain Business Incubator (BBIC), which provides capacity-building and training to young entrepreneurs, is to be noted. The BBIC services focus on counselling, the assessment of the viability of a project, and the arrangement of linkages with banks. This model is currently being replicated in other locations in Bahrain, as well as in Kuwait, Saudi Arabia, Syria and Lebanon. In Mexico, incubators also are being developed as accelerators.

In certain countries incubators are seen as a crucial instrument for internationalisation and innovation. Singapore describes itself as a global entropolis – a hub where entrepreneurs and enterprises converge, spark and realise innovations, forge partnerships and create value in manufacturing and service industries. The Singapore policy is based on a clear understanding that relationships are the essence of business. This policy has been mainly implemented through the establishment of foreign incubators in the city (see Box 2.6).

10 At the same time the number of tenants rose from 44 780 to 60 936 during the same period. See www.chinatorch.gov.cn.

Box 2.6: Singapore: Incubators underpinning a relationship hub

In Singapore, the number of business incubators and accelerators has increased threefold during the first half of the 2000s over a period of five years. The proportion of foreign business incubators and accelerators has also grown more than tenfold during the same period. They focus on nurturing and supporting foreign enterprises from various areas such as Europe, the USA, Pacific Asia and also more recently, enterprises from emerging growth areas and new geographies such as Dubai, Saudi Arabia and Switzerland.

The current 101 business incubators are incubating more than 1 100 enterprises. These include the Chinese Torch centres established by the Ministry for Science and Technology to facilitate internationalisation of Chinese enterprises and JETRO (Japan External Trade Organisation) business support centres set up in 2001 to assist start-up SME from Japan to establish and grow their operations in Singapore.

The overseas incubators assist Singapore in entrenching itself in regional growth patterns. The policy aims to mould the behaviour of both Singapore and the foreign companies in such a way that Singapore becomes the natural nexus of business ideas and deal making. The incubators also serve as recognition by the countries establishing them in Singapore that internationalisation requires them to do more than assist domestic companies to export from their domestic base.

Another example of the focus on internationalisation is the Singapore-managed Vietnam Singapore Investment Park located in Vietnam. Singapore encourages its domestic firms and others to locate operations to the business park in Vietnam. The projects seek to leverage on the complementary strengths of both Singapore and Vietnam – Singapore in R&D, advanced manufacturing and logistics, and Vietnam in low-cost manufacturing and market potential.

Source: Shanghai Municipality Science and Technology Commission, 2006.

8. Supplying finance for innovation development

Governments increasingly recognise that business innovation is more than just R&D. They know that providing incentives and promoting a good environment through diversified real services supply and innovators cocooning is necessary, but not sufficient. Beyond the access to R&D and physical facilities such as the incubation discussed above, technology commercialisation requires adequate access to capital, given the uncertainties surrounding the innovation process and the correlative needs of innovators for a robust financial base. Early development of new products and processes often generate no profit. Bridging the financing gap is therefore crucial for new firms and the autonomous development of innovation projects.

8.1 Venture capital

Finance for innovation is usually from internal sources, i.e. cash flow, but for substantial investment external financing may be sought. Nevertheless, levels of uncertainty are high. Outside investors may not be confident in managers embarking on risky projects, or they might consider it difficult to identify good projects. Long-term investment may be sacrificed to short-term approaches. This myopia regarding the innovation market warrants government intervention and the use of public money to provide grants and incentives to innovating firms and entrepreneurs.

Bank loans, particularly for innovating firms and start-ups, may be perceived as risky. The extent of this issue may vary from one region to another. One response to capital market imperfections of this type would be for small firms to form consortia to guarantee their own loan applications. An advantage of guarantee associations is that the evaluation of loan risks may be done more effectively by association members working in the same industry, while peer pressure may also help to ensure repayment.

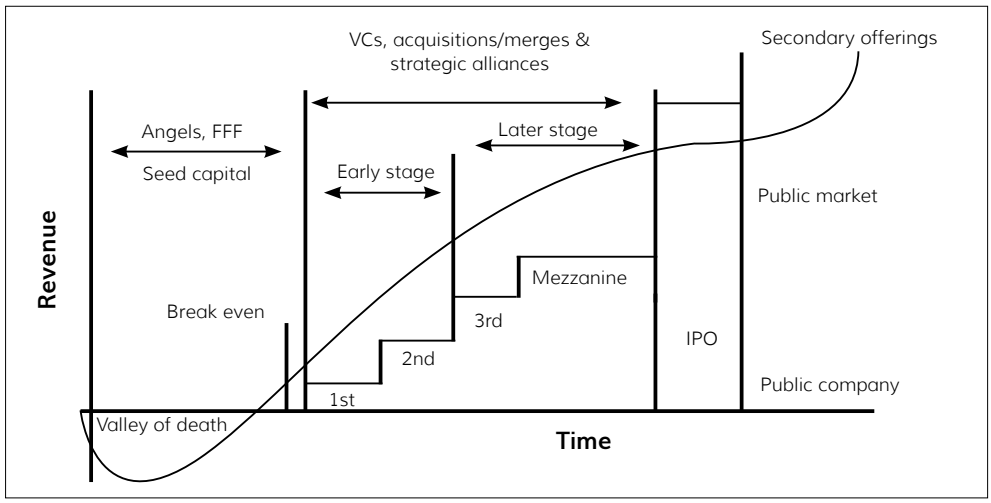
There are many potential institutional arrangements with credit guarantee associations, although a key issue is the size of the group. Peer pressure and the ability to screen proposals thoroughly may be greatest with a small group, which underlines the importance of the local dimension in such schemes. VC can also provide funding, notably for large projects with rapid growth potential, but this only concerns a very small proportion of businesses and would not be appropriate for small projects. This is part of the reason why a number of countries have introduced schemes to facilitate the financing of business start-ups. Careful management of such schemes is critical as they can easily become a source of inadequate subsidy.

In many countries the provision of VC tends to lag behind. This is also the case for private equity (PE). The main reasons are that on the supply side a traditionally based-bank system of finance exists, and on the demand side is a comparatively small high-tech sector. The structure of capital supply is that of a young, but evolving market. It is still dominated by banks as the major source of finance, although their share is declining. This situation is relatively common in a number of OECD countries that are relatively small, such as Austria and other central and eastern European countries (OECD 2005).

One of the key factors limiting the successful commercialisation of research outcomes is the lack of early-stage investment capital, because the private venture capitalists are reluctant to invest at the uncertain stage of new product development which represents the pre-seed and initial seed financing stages. This presents great policy challenges in all countries. Difficulties might also arise from the initial public offerings (IPO) of shares on the stock market, like lack of institutionalised markets. Post-IPO New Technology-Based Firms (NTBF)

may meet obstacles raising second and subsequent tranches of finance. NTBF who wish to grow significantly will sometimes have to compete with companies in order to exploit the opportunities afforded by the rapid early growth demand (see Figure 2.2).

Figure 2.2 Financing cycle



Source: Cardullo, M. 1999.

In order to reduce these constraints and induce venture capitalists to the projects to transform the research output from universities or public laboratories into commercial success, industrialised countries have improved stock market regulations and intensified supports for VC through the following actions: by allocating more budgets to invest VC, especially targeted at SME or technology-based start-ups; by providing tax incentives to non-resident investors; and by forming partnerships with private venture capitalists.

8.2 Examples of policy measures

In line with the rebound in VC markets after the burst of the 2000/2001 technological bubble, dedicated support for start-ups and new ventures has recovered in many countries (see Box 2.7).[11] Most countries have several

11 In 2004 in the USA, Europe and Israel, an aggregate of USD 25.7 billion was invested in 3 222 deals and the year was described as "the beginning of a new VC cycle." VC actively developed during the following years. In the early 2010s the USA was clearly in the lead with VC investments in 3 496 deals amounting to USD 23.4 billion in 2010. In terms of VC per capita, however, Israel was ranked first with USD 170 per person compared to USD 75 for the USA and USD 7 for Europe. See NVCA (National Venture Capitalist Association). 2012. Recent Statistics and Studies, National Venture Capitalist Association, Washington, www.nvca.org.

schemes for new firms and SME, including general SME guarantee schemes and matching of Small Business Investment Company (SBIC) by public loans in the Netherlands, seed capital schemes in Norway and Germany, and enhancing equity (high-tech double equity) in Austria.

Box 2.7: Public venture capital programmes: the international experience

Several European and Asian countries have established public VC funds. In Germany, the *Kreditanstalt fur Wiederaufbau* (*KfW*) and *Tbg* developed public venture programmes. Combined with the *Länder* (state) programmes this ensured a relatively even regional spread of funds. By contrast, in the UK, funds are heavily concentrated around London.

Main lessons to be learnt from this international experience include:

a. Public VC programmes only work when there is a strong interaction with the private VC market.

b. VC is only effective when focused upon a very narrow range of new technologies. Hence a diverse portfolio spread across many sectors may not succeed.

c. Successful private funds are both flexible and active. They are involved with the inevitable shifts in direction and personnel associated with fast moving companies. Public funds require the same involvement.

d. Public funds have to be ruthless in jettisoning underperforming companies. Performance has to be judged according to the criteria of the private funds.

e. While public VC funds need to emulate the private sector, they still have a useful role to play.

f. Public funds can be used to demonstrate to financial institutions the presence of a potential market.

g. Public funds should be more patient than private funds in performing the role referred to above.

h. The experience of OECD countries is inconclusive as to whether public VC funds supplement or lead the provision of VC. Such funds are generally young, with assisted firms having insufficient time to grow.

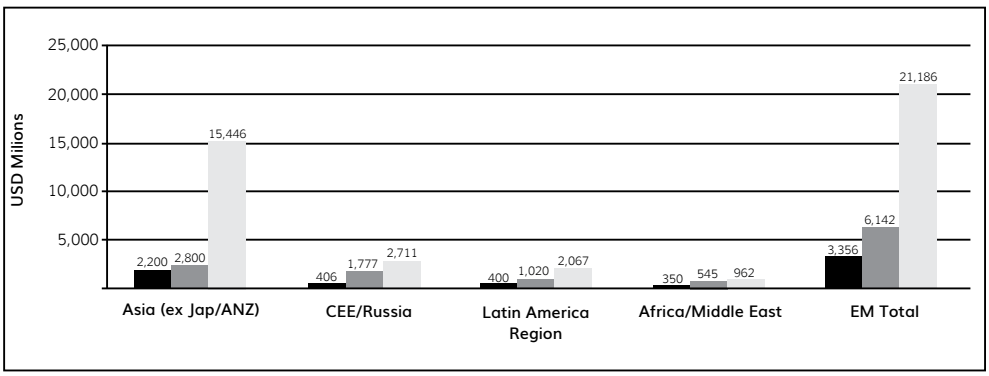
Source: OECD, 2006b.

Capital investment grants in the UK are provided in the form of financial support to encourage sustainable development and job creation in the most disadvantaged areas. Other schemes comprise export credit guarantees, which is government backed and guarantees insurances and reinsurances against the risk of non-payment to help exporters to secure overseas contracts. In order to provide enterprises with the skills and expertise to secure private sector funding, a combination of specialist information and expertise is offered.

In Japan, South Korea, Central Europe, and Nordic countries such as Sweden, the financing and incentive structure of the national innovation system has primarily been geared towards stimulating productivity improvements and growth in large manufacturing groups. The general incentives for starting firms and generating SME growth have been weak and these countries are not particularly well equipped with public pre-seed financing mechanisms.

The financial environment to support innovation, which clearly varies by region, is also a great barrier in many emerging countries. In China, when regional actors speak of VC, it is usually from public sources. For small firms, access to bank loans is repeatedly cited as a major barrier for their investment in innovation and overall development.

Figure 2.3 Emerging markets private equity fundraising (2003–2005)



Source: OECD, 2006b.

Nevertheless, Shanghai does report an active private VC community ofover 200 for the biotech industry. Weaknesses in the financial environment can also serve to explain the lesser economic impacts of certain innovation investments. In MENA (Middle East and North Africa) countries, if PE fundraising is limited, individuals with a high net worth can provide a base for VC finance, thereby acting as a substitute for institutional investors or bank finance (see Figure 2.3). In addition, according to a 2005 Deloitte study, PE/VC firms based in Europe and the USA are seeking opportunities to invest abroad and are interested in investing in emerging markets. Since risk capital rests upon equity participation, it is also well suited to Islamic models of finance (that prohibit interests) as exemplified by the success of the Bahrain-based VC bank launched in 2005.

Countries such as Morocco, Israel, Jordan and Egypt have introduced public guarantee instruments in cooperation with banking sectors in order to meet the borrowing requirements of young firms. But these efforts are not sufficient to meet the entrepreneurship financing needs in the regions, all the more as

start-ups require funding for the period during which they are not generating revenues to cover expenses. Despite its recent growth, the PE/VC is still at an early stage of development. Unlike their USA and European counterparts, MENA countries have yet to develop strong VC capital markets or PE/VC associations. The establishment of the Gulf Venture Capital Association (GVCA) is a step in that direction (see Box 2.8).

Box 2.8: Gulf Venture Capital Association

The GVCA has been created to disseminate VC knowledge and best practices in the region through conferences, technology fora and workshops. It is not clear, however, how MENA countries outside the Gulf will be involved in these activities. The GVCA will have to face the diversity of financing requirements and the differences in state development of the VC industries in the region.

Source: OECD, 2006b.

8.3 Business angels

An important source of informal equity capital is the so-called angel investment. Angel investors often provide critical know-how, as well as capital. Studies suggest that in some countries, such as the Netherlands and the USA, this investment source may be significantly larger than the formal VC market. Evidence from the UK suggests that informal investors in small firms would make additional investments if presented with suitable project proposals. In these circumstances, public policy could help the supply of relevant information. An initiative has been launched in the USA to create a so-called Angel Capital Electronic Network (ACENet).

The importance of business angels networks is recognised everywhere, but their strength is quite variable. There are only 3 500 of them in France. These numbers are ten times more in the UK and a hundred times more in the USA. Some networks are financed publicly, such as the Federal Ministry of Economic Affairs and Labour in Austria, but also increasingly by membership fees and donations. The i2 network in Austria is one of the oldest in continental Europe. According to some evaluation, the number of transactions in this network has not reached critical mass.

9. The new trend for bridging institutions: Targeting clusters and networks

In the last two decades clusters have developed in all market economies and have increasingly appeared as an efficient mode of organisation combining the advantages of competition and cooperation within groups of firms localised in a relatively limited economic space. Clusters provide a favourable environment

for innovation and technology diffusion. Within this context firms can benefit from a number of economic advantages that can be translated into productivity gains and growth opportunities which mean a larger market for workers with specialised skills, more rapid information flows and knowledge diffusion and trust between contractual parties – favouring cooperation and specialisation. In Italy, both employment growth and productivity are higher in clusters than in other regions. Firms that are part of industrial districts tend to have a rate of return to investment and equity that are 2% and 4% higher respectively than in isolated firms. Firms in these districts are also more innovative.

Clustering has not only extended in the advanced countries, but also diffused largely in emerging and less developed countries and regions. The metalwork and textile industries in the Punjab, the cotton knitwear industry of Tirupur, the diamond industry of Surat, the engineering and electronics cluster of Bangalore, the footwear clusters of Agra in Uttar Pradesh in India (see Box 2.9), the Sinos Valley in Brazil, Trujillo in Peru, the shoe clusters in Leon and Guadalajara in Mexico, the South Korean textile cluster in Daegu, the sports goods and surgical equipment in Sialkot, cutlery in Wazirabad, and electrical fans in Gujrat in Pakistan are all often quoted. In African clusters, the inter-firm division of labour and institutional support tend to be less developed, as observed in the metalwork, furniture, garment and other clusters in Kenya, Zimbabwe and Tanzania. Most of these clusters are clearly not only "low road to competitiveness" clusters, i.e. competing on the basis of low prices, cheap materials and numerical labour flexibility, but also concentrations of firms exhibiting some elements of the "high road", such as innovation, quality and functional flexibility.

Governments are now realising the importance of these clusters, both as a significant share of the economy and as a main driver of its innovation performance.[12] Experience in developed countries also shows that specialisation and cooperation between SME can be efficiently promoted through public institutions, because directing policy towards groups of firms lowers transaction cost and facilitates learning. Through targeted, collective measures, instead of subsidies to individual firms, policies can promote investment in both physical and intangible spheres, as in fora for exchange and cluster animation that improve the relational capital. These services can be provided by groupings

12 Clusters account for a significant and growing share of industries and services. In Italy industrial districts (clusters of firms in the same activity) output generates more than 40% of the manufacturing production and more than half of industry exports. In the Netherlands they represent 30% of Dutch output and employ 22% of the workforce in Norway. While clusters are common in high technology industries in order to facilitate research cost sharing and to overcome complexities of innovation, conglomerations of firms extend to all types of industries and notably traditional industries such as garment, knitwear, tiles, crafts or mechanics. According to Porter, clusters usually referred to as HT make only 8% of traded employment and 2.5% of total USA employment in the mid-2000s. Most populated clusters in the USA include business services, financial services, tourism, education and knowledge, distribution, construction and logistics.

of local actors whose knowledge of local needs and capacities is strong. Initiatives revolving around strengthening the demand side of clusters, notably for technological services and improving the work of intermediaries, linking participating firms with international firms within the framework of parks and enhancing cooperative links through broker and related programmes are of essence.

Box 2.9: Small and medium-sized clusters in India

With a contribution of 40% to the industrial output and 35% to direct exports, the Small Scale Industry (SSI) sector has achieved significant milestones for the industrial development of India. Within the SSI sector an important role is played by the numerous clusters that have been in existence for decades and sometimes even for centuries. According to a United Nations Industrial Development Organisation (UNIDO) survey of Indian SSI clusters undertaken in 1996 there were 350 SSI clusters, and approximately 2 000 rural and artisan-based clusters, in India. It is estimated that these clusters contribute 60% of the manufactured exports from India. Among the larger clusters the following are worth mentioning:

a. Panipat accounts for 75% of the total blankets produced in the country.

b. Tirupur is responsible for 80% of the cotton hosiery exports.

c. Agra, with 800 registered and 6 000 unregistered small scale units, makes approximately 150 000 pairs of shoes per day with a daily production value of USD 1.3 million and exports worth USD 60 million per year.

d. Ludhiana, a city that is known as the Manchester of India, alone contributes 95% of the woollen knitwear, 85% of the sewing machines and 60% of the bicycle and bicycle parts.

e. The world famous cluster of Bangalore, operating in the software sector, deserves an explicit reference.

Despite such achievements, the majority of the Indian SSI clusters share significant constraints like technological obsolescence, relatively poor product quality, information deficiencies, poor market linkages and inadequate management systems. Moreover, with the Indian economy on the path of liberalisation, all SSI clusters (even the best performing ones) are increasingly feeling the competitive pressures coming from the international markets.

Source: UNIDO, 2002.

9.1 Improving cluster access to know-how and international markets

Individual SME rarely have the resources or connections to take advantage of the global wealth of products and process ideas. One way for them to overcome this barrier is to pool resources and act together. Joint participation in international trade fairs are an example. Participating in these fairs not

only constitutes selling, but also provides learning through direct contact with potential customers. Trade fairs were central to the development of the Sinos Valley shoe cluster of Brazil. Joint action in the early 1960s led to the setting up of their own regular trade fair, which attracted buyers from all over the country. Subsequently groups of producers went to trade fairs in the USA and Europe. Organised by local business associations and subsidised by government, these groups played a vital role in connecting the existing cluster with international buyers and providing a driving force for improvement. Joint participation in trade fairs was also critical for ceramic producers from the Philippines who launched themselves internationally in the 1980s. With external support they exhibited a range of products at European fairs.

Another possibility is to rely on a local technology institute, funded by government or foreign donors. Cluster development institutions can drive firms to take certain kinds of collective actions such as cooperating to acquire new competencies while remaining competitors in other product markets. In Taiwan, small firms have been encouraged to team up in R&D where the technological guidance is provided by a public laboratory. A catalyst role is also played by the Ministry of Economic Affairs and by trade associations.

Collaborative institutions, councils or associations that represent a cluster provide it with a sense of identity and with mechanisms to receive contracts and grants. They can convey and aggregate the demand of participating firms for specific types of services (see Box 2.10). They are also useful for organising an advocacy function for the clusters and to voice their interest. Finally, they encourage the definition of common standards, rules and norms that stimulate competition or increase efficiency and set up an agenda for growth.

Policy measures in advanced countries usually include programmes to stimulate cluster development and facilitation support. Recent development initiatives are underway in New Zealand via the New Zealand Trade and Enterprise (NZTE) to foster growth and innovation in the existing clusters. There are over forty cluster development initiatives in progress in a range of areas (biotech, optics, pharmaceuticals, organics, software, film and wool). The NTZE's Cluster Development Programme provides a total grant of up to NZD 50 000, which must be matched by the applicant and is available to contract a cluster facilitator to significantly progress the development of the cluster.

Similar mechanisms are being operated in emerging countries. In Mexico, state governments have developed methodologies to assist member firms in clusters. In Tamaulipas (thirteen clusters identified), the government helps them through the secondment of facilitators. In the case of the electronics and telecom clusters, the main task of the facilitator consists in identifying firm needs and in assisting in building capabilities to meet these needs through the creation of skill profiles to transmit to universities so that they will be able to develop the appropriate curriculum. In addition, the Regional Maquiladora Association (REMAQ) initiates information sharing and has several committees

such as HR, finance, technology, etc. that can provide expertise. There are expectations that the firms in the telecom cluster will share design practices in the futures.

Box 2.10: The role of trade associations in Italy

In Italy, the main trade associations representing small firms identify cooperation opportunities, suggest ways in which firms can link their complementary skills, create contacts among potential partner firms and motivate the firms to cooperate and mediate critical phases in the process of establishing a network.

In Bologna, one of the three major trade associations, the CNA (Confederazione Nazionale Artiglianato) has about 17 000 member firms, forty-one local offices and 500 employees. CNA prepares 22 000 pay packets each month for 5 000 firms. It keeps the books of 10 000 firms, prepares the income tax declaration for most of its members and organises eighty training courses a year on subjects ranging from management and business administration to computing and foreign languages.

In the 1950s, this organisation promoted a large assessment and guarantee consortia in Bologna which today has 7 500 member firms and guarantees some USD 12 million in loans. So far, it has promoted forty-one other consortia dealing with production, common buying and selling that today have 8 000 member firms and forty-two industrial parks in which 1 030 small firms are located.

Source: OECD, 2001.

9.2 Creating favourable conditions for the co-location of firms

Tacit knowledge is critical to innovation and is not easy to communicate. Furthermore, obtaining it necessitates practice, learning and interaction and it is widely accepted to be the basic input in technological innovation. Innovation in a firm increasingly requires an active acquiring and exploitation of knowledge from other firms and public research organisations (PRO). Geographical proximity among learners becomes critical, thus giving a significant advantage to cluster formation of development.

The science park is an instrument that is used to encourage these agglomeration processes. Although science parks have registered mitigating results, more cautious approaches are now adopted where spillover effects are still expected from revamped parks and better designed technopoles. Cross fertilisation and value adding are intangible components and difficult to create, maintain and evaluate. Proximity needs to be organised.

While companies require support from academics, the social barriers appear often more difficult to overcome than the geographical ones. In addition, in

high-tech industries in particular, the technology required may only be available in very few places and thus links tend to be global rather than local.

In emerging and developed countries many of these parks are aiming at recruiting foreign investment through preferential tax policies and various support services. Close proximity of suppliers and subcontractors often facilitate the implantation of these international firms (in which case they tend to form some type of hub and spoke cluster). Foreign investors are assumed to produce significant spillovers to the local business sector and the spillovers are assumed to be more intense and rapid when firms are located in the same facility and are involved in organised networking, as is often the case in science parks.

In Turkey, several mechanisms aim at inducing direct foreign investment toward facilitating the active, knowledge-generating participation of local firms in increasing the innovation capacity in Istanbul and Turkish economic internationalisation. The mechanisms involve creative forms of joint ventures, acquisition of foreign technology licences and turnkey projects.

Technology parks provide an environment for catalysing strategic alliances among national and international enterprises of various sizes, university staff and the public bodies responsible for the direction and selection of projects. In addition, parks offer a suitable environment for technological start-up firms. After their incubation phase,[13] firms can be relocated to techno parks, aimed at a more mature target groups.

In China, an important objective is to replicate the success of OECD clusters by promoting such industrial and science parks, albeit their scale can be considerably larger and include a complex set of overlapping structures. What has been termed science parks in China has in fact evolved over time from being more focused on high-tech manufacturing exports to include entities that more clearly support endogenous innovation.[14] Those firms that are located in a science park hope that this will help leverage government support, among the other benefits of participation like preferential tax policies. The number of actors and the degree of government control are in any case greater than what would be found in OECD countries.

There are provincial and local initiatives for such parks, in addition to those with national level. Given their proliferation, subnational actors are now

13 In Turkey there are seventeen TECHMARKS, or technological incubators, providing common infrastructure for technological start-up firms.

14 The Zhongguancun Science Park in Beijing, approved in 1988, is one of the first examples. In this science park seventy-one HEI with 300 000 students, including Peking and Tsinghua universities, are located as well as 213 research institutes, sixty-five multinational firms and fifty-four multinational R&D centres and other intermediaries. The Shenzhen High-Tech Industrial Park in the Guangdong province, takes advantage of the Shenzhen Special Economic Zone, multiple incubators, and the Shenzhen Software Park, which serves as a base for the national (Software Industry) Torch Plan Programme.

prohibited from offering certain tax incentives. One estimate is approximately 12 300 clusters across all of China. Another count is that there are approximately 6 741 development zones (presumably also a form of park). There are 120 regional level high-tech zones in addition to the national ones (HNTIDZ), although they do not benefit from the same level of tax exemption as the national zones.

9.3 Supporting innovation in networks

Unlike clusters that do not require membership to an association or a collective entity, networks are a collection of firms working in cooperation, although not necessarily in the same place and linked by some type of agreements. One can distinguish between hard networks, i.e. small groups of companies that form by achieving shared objectives through formal agreements, and soft networks that are larger groups with more flexible internal relationships.

In most OECD countries programmes are limited to hard networks. Conversely, in the USA soft networks are predominating, because they are easier to form, require less risk and because they need short-term results. Examples include the hosiery companies in western North Carolina, metalworking in Arkansas, and Berkshire Plastic Networks in western Massachusetts. These networks mainly developed in rural areas since concentration of interdependent and similar enterprises are less obvious in less densely populated areas.

One of the most important policy strategies to stimulate network has been the initiative by the Danish government to launch a scheme consisting of mobilising and training brokers to create networks in 1989 (see Box 2.11). While this programme was temporary, it served as a prototype for many governments which then replicated the experience. This know-how was in particular exported to a great number of countries and regions, most notably Spain, Portugal, France, the UK, Norway, the USA, Canada, Australia and New Zealand.

In the USA, programmes have been state-based and modest. They were not viewed as subsidies, but more as incentives aiming at changing attitudes towards cooperation and designed for a finite period of time. Recently it has become clear that the context and environment for networks were essential. Overlaps with cluster policies have been emphasised and programmes have been embedded in cluster initiatives.

In particular networks appear as a preference customer in a host of other programmes that target goals such as creating skill alliances and technical assistance. Networks have been integrated in MEP programmes, building social capital and struggling against poverty. Networks have been "the conventional wisdom of business practices as a result of exhortation to cooperate by managers, business schools leaders and policymakers" (Rosenfeld, 2001).

Box 2.11: The Denmark network programme: brokers and scouts

The Denmark network programme that was implemented in the early 1990s offered monetary incentives to promote cooperation among firm groups of at least three independent firms that sought to commit themselves contractually to a long term relationship. Grants were provided for three different phases of network creation: feasibility studies to evaluate the potential for cooperation, planning grants to prepare an action plan or budget for a network and start-ups grants for operational costs in the first year. Eligible activities included R&D, production, joint marketing or problem-solving.

a. Network brokers
The network broker was the key to the programme and served as an external facilitator or systems integrator for network functions. In some instances, the brokers were consultants expecting to earn a living in this role, but in most cases brokers worked for agencies that already served SME. Since the idea of working with groups of firms was uncommon, Denmark designed a training and certification programme.

b. Network multipliers
These were people intimately familiar with the companies and able to detect and assess opportunities for collaboration that can be passed on to the brokers. Sometimes referred to as 'scouts', they included staff of chambers of commerce, trade associations, banks, accounting firms, law offices, trade centres, technical colleges and technology extension services that serve SME.

c. Incentives for rural networks
Denmark offered sequenced incentives to compensate small firms for some of the costs of participating in activities with uncertain returns. The Danish programme was based on the USA Small Business Innovation Research programme with a small 100% concept grant (up to USD 10 000), larger planning grant (up to USD 50 000) and larger still implementation grants (up to USD 500 000).

d. Information campaign
Denmark also distributed information widely through the media, brochures and newsletters on the potential value of networks and funding opportunities. The distribution venues ranged from conferences to pubs. While not formally assessed, the Danish Network initiative which terminated in 1993 after 3 years of operation was considered a success on a number of grounds:

a. Five thousand enterprises became involved in forming networks out of a target group of 10 000–12 000 enterprises.

b. The idea and often also the practice have disseminated widely, such that networking has become a natural option to consider in the face of new business challenges.

c. In the interim survey, 75% of participating enterprises agreed that networking was raising their ability to compete and 90% of respondents expected that they would continue the practice of networking beyond the subsidy period.

Source: Rosenfeld, S. 2005.

The Danish model has also been diffused to a number of emerging countries (see Box 2.12). In Chile, SERCOTEC introduced an initiative designed to encourage networking between groups of firms and to provide a focus for channelling support to small firms.

A series of subprojects were established, each involving three stages:

a. Preparation – in which officials work to identify firms in a particular locality, diagnose their problems and establish the credibility of SERCOTEC.

b. Consolidation – in which a manager is appointed to coordinate the network, act as an interface with various government and marketing agencies, facilitate the uptake of training and other support services and develop better inter-firm relations.

c. Independence – after three years, participating firms are expected to take on responsibility for the manager's salary.

The idea was that the benefits to the participants were to be great enough for private initiative alone to sustain itself. Although the programme was small, results have been encouraging. Most participating firms succeeded in gaining access to new domestic or international markets. The majority of networks also showed the capacity to be self-sustaining. Government officials have been sufficiently encouraged to develop a new initiative designed specifically for exporting firms.

Box 2.12: Networking programmes: the international experience

Governments concerned with economic development have frequently encouraged large local employers to engage SME more actively in value chains. The initiative of supplier development programmes involving SME in OECD countries reflected this concern and the increasing recognition that the delivery of a final product or service to the customer involves the linking of often numerous suppliers in a value chain. SME are rarely the initiator of value chains or the final entity delivering the products and services.

Incentives for creating value chains can stem from adversity. In the UK, the Accelerate Programme was implemented in the West Midlands of England, a region suffering from a continuous decline in the motor car sector and dominated by a large company (MG Rover). Many local suppliers in the region were dependent upon this firm.

The Accelerate Programme encouraged local SME to use their wide range of skills, diversifying their customer portfolio and improving modes of production and organisation. This was achieved by the provision of subsidised consultants working closely in conjunction with firms. Over seven years, this programme assisted more than 1 000 companies and safeguarded more than 16 000 jobs.

Box 2.12: Networking programmes: the international experience (Continued)

In the OECD review of SME in global value chains, the organisation concluded that such chains were likely to grow in importance. The review also argued that governments should seek to raise awareness of the role SME could play as well as facilitating SME financing, protecting intellectual property and helping SME comply with international standards.

Source: OECD, 2006b.

10. Conclusions

Support to innovators has become an important task of policymakers in most countries. This support is operated by a number of institutions that provide specific and relevant services for entrepreneurs and firms. In industrialised countries this real-service infrastructure has been established for several decades and has considerably improved its offer with a focus on professional, mature and very segmented services. At the same time while former technical centres tended to link with traditional and medium technology firms, more high-tech ventures have looked for other sources of expertise such as universities or advanced public laboratories. One should nevertheless bear in mind that low-tech and incremental innovation is accounting in all OECD countries for a considerable share of the GDP and employment. Such institutions are therefore a basic element of the innovative performance of countries.

Delivering real-service through networks is acknowledged as the most efficient way to maximise their contribution to regional development and innovation. Obviously cooperation is favoured by geographical proximity, institutional coordination and physical opportunities such as the sharing of space and facilities, but international communication and cooperative experiences substantially widen the scope of possible linkages. At present these linkages are only partially exploited. To be sustained, the networking trends need active encouragement by public policies.

In developing countries, support institutions have often been copied from industrialised countries. The spectrum of performance is extremely wide, not only between countries, but also within countries. A large number of these institutions do not function well. They tend to be of poor quality, with inadequate equipment and with a poorly remunerated staff. They also often exacerbate the initial pitfall of their model. First of all, they overemphasise the supply side aspect and are often out of touch with the demands of industry. Also, not sufficient attention is given to the need to enhance absorptive capacities of firms. Furthermore, irrealistic strategies with an exaggerated and inadequate emphasis on front end technologies are commonplace.

To increase policy efficiency many advanced countries tend to develop a complementary approach, putting the firm at the centre of their strategies. Policies are then designed for the support of small firms and start-ups. In the wake of these policies a comprehensive set of public initiatives and support is implemented to cover the entire lifecycle of the new product from design to internationalisation. In that context incubators play a major role for ensuring the survival rate of young companies. In developing – and especially emerging – countries, incubators have proliferated. However, the concept is not well established and policies to encourage their professionalisation are not easy to design.

The lack of finance available for the early development stages of the innovation process has been underlined not only by business circles, but also by policymakers. Industrialised countries have improved stock market regulations and intensified supports for VC through supplementary budget allocations in favour of VC, especially targeted at SME or technology-based start-ups or in forming partnerships with private venture capitalists. In continental Europe, the absence of an efficient secondary financial market explains part of the lag in VC and business creation with the best country performers, e.g. the USA. In most developing countries all these financial markets are embryonic.

Finally, governments everywhere are now more aware of the need to support clusters and networks because of their innovative potential, their collective efficiency and their increasing share in business activities. Physical proximity and the shared regional culture, i.e. shared practices, attitudes, expectations, norms and values which facilitate the flow and sharing of tacit and other forms of proprietary knowledge, are the cornerstones of these clusters. In developed countries most popular initiatives to enhance productivity and capabilities for innovation include the funding of facilitators and efforts to stimulate spillover, most notably within the framework of parks. Clusters also matter in developing countries, calling upon support policies at both the advantage of business and governments.

In view of the last remark, it should be stressed that many countries such as the UK, the Netherlands, Austria and some other European countries are increasingly concerned with the proliferation of innovation support measures over time, and the need for rationalisation and simplification. It is recognised now that innovation schemes are not all cost-effective and could be confusing for businesses. It is considered necessary to merge and simplify those schemes and to expand the number and roles of one-stop shops in the UK. Most countries are now adopting a system approach that emphasises the need to optimise the mix of supports and implement structural reform. This could also apply to many developing countries.

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CHAPTER 3

HIGHER EDUCATION INSTITUTIONS, INNOVATION AND REGIONS

1. Introduction

Advanced countries are confronted with competition from low cost countries in a number of markets and are increasingly turning their production towards higher value-added segments and more technologically-based products. Against this background, companies in OECD countries increasingly depend on access to new technologies and research results. HEIs are among the most important suppliers of this kind of knowledge and R&D. As a result, governments are trying to identify how to make the different categories of HEIs contribute more towards regional economic development and skill enhancement.

For universities, this is a relatively complex challenge that suggests both constraints and benefits. Older universities might be more inclined to develop national and international relationships and see regional engagement as a less interesting option. On the other hand they could also enjoy long-term advantages from cooperating with local and regional firms. These two perspectives, the national/international and the regional/local can nevertheless be mutually reinforcing, and the issue is often more a question of balance than of substitution.

While case studies reveal considerable heterogeneity across HEIs and regions according to the character and the extent of HEI regional engagement, abundant literature has underlined the role that HEIs can play in their region. Studies point, in particular, to the growing awareness among policymakers of the different functions of HEIs. Policymakers are beginning to see the universities and other tertiary education institutions, not just as creators of knowledge, developers of young minds and transmitters of culture, but also as major agents of economic growth and innovation in the economy. For governments the main justification for innovation-related activities to be developed by HEIs resides in the socioeconomic impact they may have and in the benefit to the regions (and the nation) which may result from new products and companies.

The link between the regional involvement of universities and the knowledge economy has been underlined in the context of more advanced regions. This has been documented by paradigmatic examples such as Silicon Valley and the role of the University of Stanford in its rapid development, the Boston Route 128 areas and the contribution of MIT, Cambridge Park and its university in the UK, as well as the role of Helsinki and Oulu universities in their respective regions.

At the same time, the potential role of universities in peripheral regions is also being explored. In the past, efforts to improve the performance of lagging regions centred on moving jobs around the country and on attracting low-wage, labour-intensive jobs into the regions by means of grants. Now contributions from HEIs are needed to help such regions restructure, raise their level of innovation and, where possible, also attract jobs of higher value.

The objective of this chapter is to give some insights on cooperative activities between firms and HEIs and their involvement in territorial economies. It will first explore the different contributions that HEIs can make in their regions. With its multifaceted functions and dimensions, such as supplying graduates, but also fostering research and improving governance mechanisms at the national and subnational levels, universities represent an economic potential that is still underused.

Therefore, attempts are made to identify the barriers that hinder the development of cooperation between firms and HEIs, and the reasons for government intervention and support. Regional engagement policies and initiatives to improve HEI-based territorial governance are reviewed and several more in-depth pressing issues for the future are analysed.

2. The contribution of universities and other higher education institutions to regional economies

There are indeed many ways through which HEIs can positively impact the regional economies where they are located and directly or indirectly enhance local innovation processes. These include labour market supply, technology development and transfer to companies, the promotion of spin-offs, the diffusion of an entrepreneurship culture and other socioeconomic contributions.

New analysis suggests that some universities are more entrepreneurial than others not only because they develop more spin-offs, but more importantly, because they establish long-term relationships with industries, such as through the sale of technologies and licensing. Furthermore, they increasingly develop capabilities that enhance innovation, while also providing new graduates with the proper skills regarding the management and the exploitation of knowledge.

2.1 Direct impacts

The direct economic contribution to the local and regional economy is the most trivial. HEIs are employers and customers as well as suppliers of goods and services. The expenditure of HEIs staff and students has a direct effect on income and employment in the cities and the regions. They can also widen the tax base. At the same time they are consumers of local government services and products of local firms.

These interactions are sometimes called backward linkages while forward linkages designate the impact on human capital, pool of knowledge and attractiveness of the local area. In general, the economic weights of HEIs are estimated by multiplier values and employment impact using an input/output model. In regions where universities are well represented, their contribution to the regional GDP can be very significant (see Box 3.1).

Box 3.1: The regional expenditure of universities

The role of universities could be relatively important ranging from 2% to 4% of regional GDP in peripheral regions. Socioeconomic analyses have been made in the Mid-Norway region (Trondelag) when the relocation of the main National Technology University (NTNU) in the centre of Trondheim (the regional capital) was being discussed. The local impact of NTNU and the two other university colleges was estimated to be NOK 4.3 billion annually.

In Australia, the income paid by the Sunshine Coast University (Queensland) within the region is to some extent, as everywhere spent and respent within the region, creating a multiplier effect. It is estimated that, for every dollar spent, around USD 1.5 is generated in the local economy.

In North East England, the HEIs contribute to 2.3% of the regional GDP, with a total of 14 000 employees and 89 898 full-time and part-time students. The HEIs in the region not only contribute to the regional economy as a larger customer, but more importantly, the HEIs contribute to regional innovation. As one of the few assets in the North East region, the HEIs have attracted a lot of students from both within and outside the region and constitute a major component of regional attractiveness, providing a good platform for the human capital development in the region.

In a central region, the spending impact might be lower in relative terms, but still significant. The impact on the regional economy of the University of California was estimated to be around USD 15 billion in the mid-2000s (i.e. 1% of the Californian GDP), with a 3.9 rate of return for every dollar spent in state funded research.

Source: Dubarle, P. & Woyessa, Y, 2016.

2.2 Indirect impacts and knowledge effects

Universities can also influence the city and regional economy in a wide variety of more indirect ways. Some of the most significant include:

a. Supplying graduates for the labour market and often also undertaking research, providing the basis for knowledge spillovers and the creation of start-ups.

b. Acting as a magnet for the creative class and a main vehicle for city attraction and quality of life (Florida, 2002).

c. Helping to retain talents and improve the regional brand thus increasing regional comparative advantage.

d. Supplying architectural expertise to and taking part in the design of new districts and urban renaissance programmes.

e. Owning patrimonial assets and managing libraries and facilities of regional interest while being home for cultural venues.

It is assumed that the provision of graduates is an important aspect of regional development and productivity growth especially when retention rates are high. Attracting the creative class is also a key function. Universities help to connect city regions (and nations) to global flows of knowledge and talent, thereby enhancing regional competitiveness.

Furthermore, universities build social inclusion and cohesion by creating more diverse and tolerant communities (Gertler, 2004). Through this process, the universities act as anchors for creative thinking and activity within the region and have a positive effect on inward investment. Other functions such as their involvement in spatial planning and cultural life do not seem quite as crucial for the regional economy.

These and many other indirect effects are mostly the result of the diffusion of knowledge and expertise by HEIs – this constitutes what has been referred to as "forward linkages". The following sections will address some of the most important of these forward linkages that have a particular importance for regional innovation.

2.2.1 The supply of intellectual capital to the labour market

Depending on the retention rates of graduates in the regional labour market, HEIs can provide crucial human capital input for regional and local firms. In theory, by supplying knowledge in the form of educated people, HEIs increase the capacity for generation and absorption of knowledge and innovation in the region. The presence of this educated labour force is instrumental in nurturing a specialised labour pool, in inducing affiliation to laboratories, and helping to attract and retain firms.

Different types of HEIs play this role to differing degrees. Tertiary education is made up by more than just universities. As the World Bank (2002) pointed out: "the diverse and growing set of public and private tertiary institutions in every country – colleges, technical training institutes, community colleges, nursing schools, research laboratories, centres of excellence, distance learning centres and many more – are forming a network of institutions that support the production of the higher-order capacity necessary for development."

Different HEIs have different impacts:

a. Universities influence regional development through the recruitment of graduates, postgraduates and, increasingly, foreign students. They also have a direct key role in upgrading the skills of both large firms and SME through student placements and industrial fellowship schemes. When regions are urbanised, retention effects for students are more important, but relatively variable. In order to adjust curricula and increase the employability of their students, some universities have set up anticipation mechanisms for occupation skills through the evaluation of requirements and educational needs in the region.

b. Polytechnics or new universities have a more local recruitment. At the undergraduate level these institutions have begun to provide dedicated degrees and certification courses to suit the need of local employers. In general, these institutions have stronger local retention rates.

c. Technical colleges have long provided vocational courses as well as generic training. Their role in helping local firms is often underestimated. They provide training for technicians, an employment category with an important role in innovation (Rosenfeld, 1998).

From a regional economic development point of view, it would be tempting to argue that polytechnics and community colleges, due to their local base and embeddedness, are more effective for the regional economy and small firm development in particular. While there is some truth to this argument, in reality it is not as clear-cut. Many universities – notably research universities – are strongly involved in their regions. The fourteen universities of the Oresund, with 130 000 students, regrouped in the Oresund University Association,[1] have been a driving force for consolidating the cross-border region, enhancing its dynamic, setting up sectoral organisations and organising fora and training for regional clusters. In addition, universities can help small businesses to network nationally and internationally. They can also play a key role in gathering and interpreting labour market intelligence (Bachtler, 2004). As a consequence, cooperation between universities and polytechnics are increasingly viewed in many countries as a means to develop synergies and improve the offer of services for regional clients, while collaboration with community colleges seems less commonplace.

2.2.2 The provision of technology and research output

In recent years it has become increasingly clear that very few firms can independently master the innovation process from the initial idea to the introduction of a new product or process on the market. The challenge for

1 Oresund Org has been recently decommissioned, but Oresund University continues as Oresund University Network focussing on educational collaboration between participating institutions.

firms is to link up with the best universities and research institutes, whether or not they are local, to gain connections to international science from university researchers. Three main types of relationships are often distinguished:

a. Relations between multinational enterprises and world+class universities where multinational enterprises are externalising part of their R&D activities and are looking for the best laboratories, scientists and students.

b. Relations between research universities and small high-technology firms.

c. Relations developing in a regional context between firms, often SME and the local university or polytechnics. Here firms are looking for short-term, problem-solving capabilities. These services and advice are often promoted by means of regional clusters around HEIs. According to certain studies the presence of at least one large firm in the clusters seems to improve the relation with university research (OECD, 2007).

While HEI technology and research output can be available not only for regional users, but also for users outside the region and even in other countries, it does nonetheless seem that proximity is important for HEI-industry relationships (as stated above). Proximity also affects faculty consulting and recruiting of students, which are other important channels for industry/university relationships (both are often ranked higher than patenting and licensing). Depending on specificity of countries, universities exhibit different patterns with regard to these activities (OECD, 2007).

2.2.3 The promotion of spin-offs and the diffusion of an entrepreneurship culture

Universities are often well placed to foster an entrepreneurial culture and build entrepreneurial capacity. As well as providing specific services such as problem-solving, consulting and counselling to established SME, research universities are sources of new firms and usually have mechanisms in place to support their formation and growth (see the case of Twente University). Universities often create science parks or similar facilities to facilitate spin-offs and to encourage synergies with innovative businesses (Smith, 2003). Many studies have shown that university-based science parks perform better than those that are not university-based. However, they are not a panacea (see Chapter 1). For SME the evidence in support of the positive effect of networking with the science base provided by a park is limited. Various studies of matched samples of firms on and off a park have revealed little evidence of significantly enhanced performance by the science park enterprise.

Entrepreneurial performances do not rely only on skills, availability of business training and an appropriate physical infrastructure. It often also draws on networks and collaborative relationships to foster spillovers. This has often been seen as a reason for the formation and growth of successful clusters of

innovative firms. A number of channels have been established by universities to facilitate clustering among key actors, including prominent research staff. These provide public space, platforms and fora to enhance the propensity for cooperation among firms and between firms and other actors. HEIs also have an increasing role in building networks and contributing to nurturing social capital by facilitating interaction and learning among people in different organisations. A particular form of networking is mentoring, which can help pass on the skills of established entrepreneurs to fledging companies. Again this process can sometimes be actively promoted and animated by universities or related bodies.

2.2.4 Other contributions to socio-cultural and policy development

Work with social services: It has been stressed in many case studies that universities and other HEIs have a socio-cultural mission in their portfolio. There are examples of academia providing social services, often in partnership with NGOs and other groups in areas of health and welfare, to offer possibilities of upskilling for service and care providers. Placement programmes can also help to support social enterprises. It seems, nonetheless, that relatively few HEIs extend services on a systematic basis to disadvantaged communities

Contribution to cultural life: HEIs have always been active in cultural matters. Their participation in art festivals, music and entertainment programmes is considerable. This can have the added benefit of attracting and retaining graduates and skilled workers looking for a residential location with a strong cultural life, often provided mainly by universities, particularly in smaller cities.

Consultancy and policy advice: A further advantage available to regions with universities is the availability of technical and policy advice, with many universities strongly active in consultancy activities. Universities are increasingly called upon to help in the design of foresight exercises or in building long term strategic visions. This involves working closely with government and other key actors. In countries such as the UK, education institutions have been important in driving the process of regionalisation and in articulating a spatial strategy.

In all these domains, universities and other HEIs have a potential that can be enhanced. In particular, given the accumulation of knowledge in universities in the last decade and their underdeveloped relations with new and existing small firms, there is still room to further improve the supply of technology services and the development of spin-offs. However, the broadening of the role of universities is not straightforward and remains to be worked out.

While the regional engagement strategies of universities depend, to a large extent, on the role a given university chooses for itself and the leadership role it adopts, they are also constrained by important factors. From the regional policy point of view these barriers can be of three types:

a. Linked with the characteristics of the national education system

b. Related to lack of resources.

c. Regulatory problems and other obstacles in collaborating with third parties such as firms, NGOs or even local governments.

3. Regional involvement of higher education institutions

3.1 The characteristics of national education systems

The significance of national education systems remains high in most OECD countries, especially in European countries and Australia, though there are some important variations. In continental Europe and especially in France, Germany and Italy, systems of HEIs are heavily centrally managed and pressure and incentives to engage with regional actors are low.

In contrast, Scandinavian and Anglo-American countries have recently promoted greater institutional self-management and encouraged greater regional engagement. But even in those cases there are aspects of central regulation that have an impact on engagement. The Swedish parliament amended the HE law in 1997 and Swedish universities were instructed to undertake an additional role beyond teaching and research, i.e. cooperation with the outside world and the promotion and development of society at large.

The characteristics of the central system significantly influence the ability of HEIs to respond to growing demand and to engage in regional development. Some HEIs operate within a national system that grants them much institutional autonomy in terms of the orientation of teaching and research activities, while for others the regulatory framework exerts a strong influence on the orientation of the institution.

The type of university is also important. The mandate of university colleges and community colleges often specifies their function as regional stakeholders assisting firms and promoting economic development, while such a role is not usually defined for universities.

A number of national contexts have demonstrated these concerns with territoriality. There have been clear moves towards a regional agenda in the UK with the establishment of regional advisory groups within the Higher Education Funding Council for England (HEFCE) and allocations of budget through the Higher Education Innovation Fund (HEIF), which emphasises the cooperation with regional communities and other specific third strand programmes.

Some evidence of evolution can be seen in other countries, such as in France, which is slowly moving from a heavily centralised system. In Finland, a number of HEIs were created as part of the policy of the government to encourage regional development in remote areas.

3.2 Barriers to the cooperation between higher education institutions and firms in the field of research and innovation

Many studies show that HEIs are a relatively minor source of information. Overall the results indicate that sources within enterprises are the most important for innovation. The second reservoir for new ideas is suppliers of equipment, materials and components, followed by clients and customers.

In fact, universities, firms and mainly small businesses experience significant gaps in their collaborative relations. Firstly, they might have divergent objectives and priorities, as well as difficulties locating partners. Secondly, universities sometimes do not find sufficient interest in research topics proposed by businesses, while firms often favour a more commercial approach than the one followed by academia. Thirdly, restrictions on publishing research results may act as a disincentive for universities.

However, these gaps can be bridged or reduced if both partners clarified their main motivations – the need to find new resources for academia and the accession to new technologies for the firms. In the case of market failures, framework for partnerships and incentives can help both parties to come to an agreement.

Universities and other HEIs are nevertheless becoming important players in the regional context and are in any case more interested than before to increase both their cooperation with business and international competition. A faster phase of technological development has made enterprises more receptive to external sources of innovation and the recruitment of skilled people and graduates. It does not necessarily follow, however, that university supply of skills and services spontaneously match the demand of the firms. Beyond some "traditional" obstacles to innovation, e.g. the lack of entrepreneurship, overregulated markets, insufficient R&D by the private sector and underinvestment in basic research, systemic failures are common, such as institutional rigidities in the research system and informational problems with firms. These failures emerge for different reasons:

a. They can be cultural. Firms and HEIs are run by different logics. Firms are market oriented, while universities are often more concerned by the supply of knowledge and publications than by patenting activities or introducing applied technologies in markets. In addition, research freedom and scientific merit may come into conflict with the idea of valorising university knowledge, as is the case in Spain and France. This can be different in regions with high social capital and/or a tradition for cooperation as in Alsace or Rhone-Alpes in France.

b. They can be inherent to the commercialisation process of new ideas. Often researchers face specific barriers that deter them from entering the commercial arena. This has to do with the lack of access to early stage

capital, the shortage of the necessary management and entrepreneurial skills. Furthermore, the absence of relationships between researchers and industry, lack of skills in negotiating equitable commercial arrangements and protecting the integrity of ideas and solutions, as well as unclear or inadequate incentives and infrastructure to support and reward academics and researchers who engage in commercial activity play a role. A cultural gap between research/education institutions and business is also often a cause.

c. They can be linked with the attitudes of small firms towards innovation and their underspending in R&D. It is not only the absorption capacity of small firms that poses a problem, but also their lack of information about what universities offer and their inability to formulate a demand that the university could respond to with an acceptable level of transaction costs. As a result, although small firms are often in a greater need of cooperation than other firms, their degree of interaction with universities is significantly lower than for larger firms. In many cases it might be easier for small firms to work with the polytechnics and the community colleges. Nonetheless, information about what the polytechnics do, is often not much more visible than in the case of universities.

While these market failures can justify appropriate government initiatives, cultural issues might be more difficult to address. Experimentation and pilot actions by the Ministry or by HEIs can facilitate a better understanding between partners, but time is needed for proper results to take root.

Governments could be more active to improve commercialisation processes and to develop incubators and science parks. In that context, it might be important to promote an integrated approach to firms not only focussing on technological aspects, but also on legal, workforce and infrastructure issues. Meanwhile, improving the demand by firms may require specific programmes. These aspects will be dealt with in the next section.

There are also institutional remedies to these problems. Bridging the gap between firms and HEIs can be facilitated by the presence of intermediary institutions. However, as stressed by some economists, these approaches are not without risk. It has been argued that these organisations could institutionalise and cement a low interaction between HE and industry and contribute to keeping the institutions of science and economy apart.

In these organisations there might be a tendency to attempt selling and marketing research that has been initiated with insufficient attention to demand, according to a traditional technology push approach. It might be costly and difficult to transform such artefacts into market opportunities or even to patent and license them.

Other aspects include lack of incentives and rewards to cooperate with firms. For the university management, the decision to embark on providing services to firms, establishing technology transfer offices and undertaking patenting and licensing activities is not easy, all the more as national or regional authorities put the HE sector under significant pressure to increase efficiency. Such new activities are often risky endeavours that do not guarantee appropriate returns at least in a short-term perspective.

Moreover, it is important for HEI researchers that ownership and utilisation rights are clearly defined with regards to the partners involved. Legislation with regard to property rights is sometimes relatively old and does not take into account varying funding practices and complicated contractual arrangements. New legislation is needed to clarify and enhance the utilisation of inventions made in HEIs, as can be seen in Finland for example.

Certain universities see them as operating in different playing fields with regard to polytechnics and community or university colleges (see Box 3.2). Conversely, it is clear that polytechnic, *fachhochschulen* and colleges are more oriented towards filling the need of the regions, whereas many universities are characterised as more national and international operations. For these reasons universities working for the region are often undervalued. These dividing lines may hinder the capacity of HEIs to collaborate and offer some type of consortium responses to the demand of firms and communities.

Box 3.2: The specific role of community colleges

Technical colleges in many parts of the industrialised world have altered or amended their core mission statements to enable them to address technology development and skill needs of companies in their regions. Peripheral, education-related technology services and resources of the colleges have become increasingly important, particularly in rural and less advantaged regions.

Although technical colleges admittedly pay more attention to larger employers than SME, they are fundamentally more accessible and less intimidating than universities to SME owners who rarely hire the graduates or use the extensive resources of universities. The widely decentralised and applied technical colleges are the leading source of technological expertise, know-how and knowledge infrastructure of the core of regions.

Perhaps the most underrated and undervalued contribution of technical colleges to technology-based development is its nurturing of social capital by facilitating interaction and learning among people in different organisations. These institutions play important roles in putting companies and services in touch with one another and encouraging technology transfer and information exchange. Technology is diffused most effectively through personal contract and companies learn best from other companies.

Box 3.2: The specific role of community colleges (Continued)

The role of technical colleges, as described above, seems more appropriate for all types of regions, although their size and specialisation will differ from case to case. In high-tech regions they are expected to specialise in high-tech sectors. In industrial districts they would need to offer technology services in the existing clusters, whereas in underdeveloped regions they would limit their activities to the organisational and technology transfer needs of the local productive activities.

Source: Rosenfeld, S. 1998.

4. Government policies for better integrating higher education institutions in regional development

In the context of integration of HEIs with regional development, governments are called upon to improve the industry/science relationships and to facilitate the involvement of HEIs in the local and regional economy. This is increasingly part of their regional policy tasks, given the growing orientation of most OECD territorial policy towards regional competitiveness, increasing innovation capabilities and skill enhancement. Improving the ability of business to exploit university output of which trained researchers, knowledge, problem-solving capacities and research methods are on top or near to the top of the agenda of regional policymakers.

The key challenges that governments need to address are revolving around:

a. The need to improve the responsiveness of academia to business desiderata and to remove cultural barriers.

b. The need for universities to embark on new tasks such as R&D, innovation, joint research and services to SME.

c. The need to enhance firm absorption capacities and increase their recourse to university research.

d. The need to strengthen capacity building and institutional partnership involving HEIs.

In most countries, in order for regional policies to respond to these challenges, it increasingly rests upon a hybrid of education initiatives, innovation and cluster policy schemes, efforts to promote mobility between the academic sector and the private sector and to encourage cooperation between HEI and regional development organisations. How this policy mix is organised depends on the regional policy characteristics of the country. Clearly, the emphasis is put on points b. and c. above. However if regulatory barriers in the education systems are still significant, attention should also be directed to point a. while

targeting peripheral regions might necessitate focussing attention on point c. (OECD, 2007).

4.1 Linking with education policies

Governments attempt to influence framework conditions by passing specific acts. In South Korea, new legislation has been introduced with the Technology Transfer Promotion Act. The government also amended the Industrial Education and Academic Industrial Collaboration Promotion act in order to lay the framework for effective university business collaboration, the introduction of an independent accounting system for HEIs and the establishment of school corporations.

The emphasis was put on meeting the needs of business and accessing external funding in Finland. More freedom was given to universities to undertake activities, including research, with this purpose in mind. A new act regarding universities in the mid-2000s in Denmark also contributed to extend and develop educational portfolios and profiles with a view to follow the development in society and meet the need for new competence skills.

As a result, several universities have been awarded the permission to offer degree programmes in order to comply with regional shortage of skills and local needs. It is then the role of the university, as in the case of the University of Arrhus and the University of Southern Denmark, to supply new curricula for engineers, because of the regional deficit in those professions.

In some countries this has taken the form of dramatic reforms in HEIs so as to rationalise their roles and allow them to become nodes in RIS. In Japan, while most public research institutes were turned into Independent Administrative Institutes (IAI) during the mid-2000, the government started to implement the "corporatisation" of national universities. This sea of change initially affected national universities, but it is now also possible for other public universities to be incorporated according to the judgement of the prefectural government concerned.

In the new institutional environment university faculty members are non-governmental employees, not civil servants as before, and universities are transformed into IAI. With this administrative reform giving universities more autonomy, and the design of funding schemes channelling funds to cooperation rather than individual companies, policy implementation has been supported. University and industry collaborations have been more widely diffused into small start-up firms and it is likely that these smaller firms are gaining momentum and gradually reducing Japanese dependence on in-house R&D conducted within larger corporations.

It is now suggested that 70% of firms engaging in R&D activities are involved in some forms of R&D collaborations. The reform has also favoured mobility

and permitted the offering of part-time positions for university professors at research institutes to lead research there.

An objective of the new tertiary education policies in many countries is to enhance the development of more entrepreneurial universities. However, while it is recognised that more leeway needs to be granted to HEI managers, reducing the burden of regulation that is placed on HEIs does not necessarily proceed at a fast pace. In Denmark, reforms have introduced a wider scope for decentralised decision, while sometimes maintaining a strong element of central steering and monitoring.

The government wants to be assured that universities are capable of administering any extended degree of autonomy, which entails some type of reregulation. Over the last twenty years the policy objective of the Dutch authorities has also been to decrease rules and regulations governing HEIs. In some fields more and more power has been transferred from central government to institutes.

The plan for a new act on HE and research shows a further stage in this development, with plans to loosen control over specific programmes. However, the autonomy has not increased in all fields. New policy issues sometimes brought about new regulations. In addition, the power to decide on research priorities is partly given to national organisations through major financial incentives.

Several governments have signalled their intention to rationalise their HE system through a process of mergers that will lead to a reduction in the number of independent HEIs. These mergers have as their main objective the strengthening of the national research environment. This trend is noticeable in most Nordic countries. It is motivated not only by the ageing process in the population and the perspective of a smaller cohort of students in the year to come, but also by the need to get stronger, more internationally competitive HEIs.

4.2 Linking with innovation policies

Given the progress made in general on the HEIs deregulation front since the beginning of the last decade, a number of disincentives for employees of universities and other HEIs to work on joint projects have been eliminated. HEIs are now more able to develop their interface with business and find new opportunities to enhance research and cooperation.

For regional innovation policy, the objective is therefore to better tap this potential and to facilitate the use of HEI creativity. The two critical ways are increasing the role of tertiary education within RIS and participating in cluster type initiatives.

5. Tertiary education and regional innovative systems programmes[2]

RIS can be seen as a scaled-down version of the national innovation system trying to detect regional variations and knowledge infrastructures. Research institutes and HEIs are considered as main pillars. In addition to the institutions, knowledge bases, communication channels and mechanisms for learning and sharing knowledge are crucial to articulate innovation systems.

While it is a relatively common idea to put universities at the heart of the regional strategies, e.g. North East England, Busan in South Korea or Jyvaskyla in Finland as several case studies have shown, the implications have not been clear. HEI positioning and/or their instruments to collaborate with firms are often weak. In some countries, the number of universities equipped with liaison offices or centres of entrepreneurship is still limited. For example, in France only a quarter of universities house a commercial service department.

These departments are often understaffed as is the case in Denmark, Norway, Spain and Italy, and they are putting too much emphasis on obtaining patents and too little on exploiting them through licenses. A number of these liaisons and transfer of technology programmes are nevertheless working well in Europe and the USA (see Box 3.3). With regard to incubation and production of university spin-offs, some universities have been highly successful, like the University of Twente in the Netherlands or Grenoble in France. In the USA these spin-offs are few, and the chairs of entrepreneurship very dispersed, not exceeding 100 in Europe compared to 400 in the USA.

Box 3.3: Examples of industrial liaison programmes in the OECD

In a number of regions, HEIs with some type of research activities have often created or reorganised industrial relationship offices. The way this relationship is handled is very diverse in terms of staff, support or programmes. It could be only Transfer of Technology Offices (TTO) or Technology Licensing Offices (TLO).

It could be quite more ambitious in scope, with wide ranging programmes including industry research partnership, technology transfer, industrial extension and technical assistance or industry education and training partnerships etc., such as can be seen in many US research and innovative universities.

These universities often stand as good practices. Their business model originates in specific university leaderships rather than being the direct result of government or state programmes. However, in a number of countries, such as Finland or Sweden, HEIs have formed companies that handle the transfer of technology and these have received funding from the government.

2 Subsections 3.5 and 3.6 are an update of parts of Chapter V of the OECD report: HE and Regions, Globally Competitive, locally engaged (2007) to which the main author contributed.

Box 3.3: Examples of industrial liaison programmes in the OECD (Continued)

The MIT industrial liaison office is one of the best known models of linkages between universities and companies. Providing that they pay a membership fee, companies have unlimited access to specialised information services, seminar series and a monthly newsletter that includes details of ongoing research and outlines new inventions. The directory of MIT research activity is organised by area of expertise to make it easier to track down with specific interest, faculty visits and expert meetings for companies. It often results in consultancy or research sponsorship. The programme is particularly attractive to companies, because it is managed by a panel of Industrial Liaison Officers (ILOs), each one being responsible for a focused portfolio of companies with the responsibility to serve their unique interests and needs. While this fee-paying model might be perceived as a special case by smaller universities that do not expect to derive the same level of commitment from companies, other universities have developed "community clubs" for companies interested in their work. In the UK, Cambridge University Computer Laboratory and Newcastle University Centre for Software Reliability have both created clubs that invite companies to seminars and symposia or distributes copies of technical reports and organises exchanges of material.

While these offices usually do not differentiate between regional firms and others, some HEIs are starting to clearly identify their activities with state or regional firms. Innovative models are emerging. In the USA, Purdue University (Indiana) has established an "innovation commons", called Discovery Park, on campus. This structure is aimed at identifying technologies with special promise for commercialisation in the state. The university has also completed its regional strategy by creating an Office of Engagement and the Center for Regional Development to manage the resources assigned to regional involvement.

In a few countries these offices have been promoted directly by a programme of the Ministry of Education (MIC). In South Korea, much freedom was given to DIUC (Division of Industry/University Cooperation) to install departments at universities on a contract basis, thereby starting to build relations with companies or groups of companies that were able to formalise their training needs. Moreover, universities that focused on collaborating with HEIs have been selected through a public contest in South Korea. Universities designed as regional hubs receive subsidies over five years, local governments and businesses being required to make over 5% contribution to a kind of regional fund.

It is interesting to note that in line with the growing commercial awareness on campuses, universities are increasingly hiring executives and entrepreneurs from the commercial world to lead their institutes. This is mainly the case in the USA, but such practices are also starting to emerge in Europe. In Finland, research service units have been created to assist researchers with managing intellectual property rights (IPR) and providing other commercial services. Many universities also employ development managers. They are in need of highly professional personnel to identify client firms and deliver transfer of technology, licensing or consulting services.

Source: OECD, 2007.

On the whole most countries have tried to reinforce the HEIs apparatus vis-à-vis the firms and the regional economies, as well as their willingness to engage in the region. They have sometimes embarked on large regional projects associating a wide spectrum of stakeholders to lay the foundations of RIC, such as the New Universities for Regional Innovation (NURI) project in South Korea or the VINNVAXT project in Sweden. However, most of the time they have developed temporary incentives in the form of grants, call for projects or joint programmes to facilitate collaborative research at regional level, but seldom through fiscal advantages. Funds for regional engagement are yet not much developed. In the UK, where the regional dimension of HEI activities is among the most accentuated within unitary countries, the HEIF finances a number of business-friendly schemes for universities, but it does not seem to provide much to HEI total resources. In general, governments and their agencies have mainly invested in science parks, financed incubators and granted VC fund incentives to accelerate university spin-off, although with different emphasis and budget.

Apart from specific cases like the Flemish TETRA programmes, most initiatives which create technology transfer companies – screening and rewarding spin-offs, and financing personnel to manage industry/university interface – seem to prioritise the uptake and development of high-tech rather than traditional activities in university research. Mechanisms to support social entrepreneurship and develop innovation for wider needs of excluded groups in rural or inner cities areas are generally scant.

The focus seems rarely on services and large employment intensive sectors such as health, although biotech is targeted indirectly in a number of more strategic sectoral programmes. Furthermore, most of these programmes share funds between public research institutes and the research centres at HEIs. Moreover, the information about the distribution between the two entities is usually lacking.

6. Higher education institutions and cluster-based initiatives

Another way to involve HEIs in regional life has been to target clusters and notably cluster development programmes. There are in fact several reasons for clusters to integrate tertiary education institutions. Firstly, HEI can impact clusters through their effect on input in supplying graduates and educated people. Also, as an external factor it can also improve the quality of input and disseminate knowledge and research results. As stressed in some studies, one key role of HEI is to help diversify the local economy and allow clusters to expand their range of products and R&D base (Paytas, 2004). For that purpose, HEI can offer not only their 'traditional services' i.e. technology and knowledge transfer, licensing, consulting and problem-solving services, but also 'public space' for open ended conversations about industry technological perspectives and market opportunities.

Given that higher education institutions-based cluster programmes usually present similarities between countries, it is proposed to analyse three of them who seem to be typical.

6.1 Centres of expertise in Finland

The centres of expertise in Finland have been at the origin of a family of programmes and centres developed in other Nordic countries. The idea behind the creation of these centres is to utilise high level expertise as a resource for business activities and the creation of new jobs. Their main task is to strengthen the regional critical mass and to link it with sectoral specialisation. During the new programming period (2007–2013), the programme underwent a renewal, with thirteen competence clusters established and currently comprising twenty-one centres of expertise and six affiliate members across Finland. The objective of these clusters is to strengthen regional partnerships in innovation activity, while creating more effective development entities at both national and international level (MEE, 2010).

This programme, which is now nearly twenty years old, is considered as a success and as a top act of Finnish regional policy. Nearly 1 500 projects launched by the Centre of Expertise Programme have included participation of 19 000 SME, 3 600 large enterprises, 4 500 research and education institutes and 7 900 other organisations. It is estimated that the Programme has helped to create about 360 new companies and 3 000 new jobs (MEE, 2010).

This assessment does not exclude some caveats. In particular, the division of labour between the different HEI components of the centres is often raising questions. It should, in principle, be based on specialisation between basic research undertaken by universities and applied research performed by polytechnics and other HEI. This distinction remains, however, somehow artificial. Operative mechanisms for cooperation are often lacking and some type of competition is often developing when different HEI work in the same area. As mentioned by the MIC, there is a need to deepen collaboration and to search for new complementarities .

HEI are also engaged with other regional stakeholders such as local public companies and Science Park Companies, who represent 12% of the funding of projects. This collaboration is generally based on single operations rather than on mutual agreements. This lack of agreement could be a source of conflict in terms of strategies and of uncertainties leading to inefficient use of resources and loss of synergy benefits.

Universities and polytechnics are involved in different centres of expertise. This could form a good seedbed for horizontal innovation and interdisciplinary research. While some type of cross disciplinary platform has been established

in certain HEI, some opportunities are still being lost in others. This should become a more important priority in regional strategies.

Given the long term nature of the programme, the regeneration of regional expertise and the attraction of foreign direct investment certainly deserve attention. Governance issues are also important. First and foremost, the centres involved a large number of intermediary organisations apart from universities and polytechnics which make them more complex to organise. It is sometimes said that if centres with universities and polytechnics were assigned a leading role, it would anchor them better in national innovation systems and regional programmes (OECD Territorial Review of Finland, 2005). The argument is also reinforced by the present trends in favour of extending the centres to soft fields such as cultural industries, where HEI are playing an important role. Second, the centres have also drawn universities towards cities. But the funding system has limited their role in this respect.

6.2 Poles of competitiveness in France

The French poles of competitiveness consist of a comprehensive programme of seventy-one poles. This programme is an ambitious industry-led programme also involving the participation of numerous stakeholders and endowed with a significant budget. So far 1 300 collaborative R&D projects have been supported by the central government and the subnational authorities, half of them have been completed (DATAR, 2014).

The first phase (2006–2008) of the programme was highly successful with 105 applications filed. The programme was then reorganised emphasising the governance of the poles via improved performance contracts, the development of innovation platforms and a greater mobilisation of private funds and territorial synergies. It is now into its third phase (2013–2018) with the financing of a great number of projects within the framework of a third call for tender that went out in 2014. The focus is now on SME and intermediate sized firms and the economic benefits for the regions.

While the programme pursues a clear goal of reinforcing French competitiveness and the innovation capacities of local areas and the regions, a further challenge for the regions and their poles of competitiveness is to exploit the innovation potential offered by the findings of public research fully and to promote a multidisciplinary approach and a mix in R&D. Universities have, to a certain extent, seized this opportunity to increase their link with industry. However, their participation has remained relatively limited even in some of the poles with an international visibility.

A number of basic factors make their contribution more difficult. While HEI cover a wide spectrum of research disciplines and maintain linkages with a number of technopoles, they are undertaking less R&D than public institutes,

conversely to many countries. Their involvement is also made less easy by the compartmentalised nature of public research in France with divisions between education and research, the major research institutions and the universities, the universities and the *grandes écoles,* etc. Currently, the capacity of the universities to meet the demands of industry is limited by the fact that researchers have the status of civil servants and also by the fact that, to a large extent, they control the committees responsible for drawing up research projects. Furthermore, many research teams are mixed (universities/CNRS), which makes it more complicated to manage laboratories and relations with industry. The rectors of universities have very little autonomy which also reduces their ability to put strategies in place and commit to cooperative R&D projects with industry. Lastly, the rigidity of employment regulations is becoming more and more of an inhibition to contractual arrangements between partners in the public and private sectors. However, there are many institutions that work with non-profit-making associations that can hire staff on standard private sector contracts.

At most universities this limited presence within the poles is also due to insufficient competitiveness and organisational capacities to deal with business. For the moment, universities have neither the size nor the visibility of the high-calibre foreign universities and they are not sufficiently tied into the local institutional and industrial systems. Only the best among them, meaning the eight to fifteen premier establishments in the mainly scientific or medical fields, are beginning to introduce strategic management, notably under their four-year contracts with the State.

The present degree of latitude for experimentation might, however, generate new opportunities such as entrepreneurship centres, territorial or subject-based groupings, raising awareness among academics of the business world. Certain technological universities are members of European consortia (the University of Compiègne) and have become specialised in spin-offs and the innovation culture, but they are few in number.

There are several options to upgrade the role of the university in the poles of competitiveness and in economic life. First of all, it is recognised that universities are in short of core budget. France invests less in tertiary education than other OECD countries who are engaged in the knowledge economy. Increased funding would strengthen their position in the poles of competitiveness. Secondly, the mode of governance of universities is an element of low efficiency. French universities presently suffer from a lack of autonomy and are dependent on the Ministry to select professors or influence their earnings. Thirdly, to tackle the problem of institutional fragmentation, the creation of university consortium should be encouraged. The government has taken steps in that direction when new laws (2006 and 2013) where passed. This legislation results in support of the creation of poles for research and HE now replaced by the *Communautés*

d'Universités et d'Etablissements (CUE). A CUE agreement signed by the authorities will set forth the objectives of the new structure, what resources it has at its disposal and how its performance will be assessed. However, it is not clear whether the CUE results from real bottom up initiatives or from the decision made by the Ministry.

6.3 The Japanese cluster programmes

One main objective of the first programme (the METI programme) is to support the exchange between industry, academia and government. While a relatively large number of local governments participate in the projects and operate incubators, they also provide office space, development sites and incentives to relocate, but their capacity to facilitate networking is quite limited especially with academia. Given that most of the financing is local funding, much depends on their proactive approach in that field, as well as acquiring experience and the assistance of METI experts.

Recently, the METI programme was conducted simultaneously with a programme on knowledge clusters initiated by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). While the METI approach was targeting existing industrial strengths, the MEXT programme was focused on universities with the aim of making them cooperate with industries and commercialise new technologies. The emphasis was on creating human resource-based or proximity-based networks that encourage stronger face-to-face interactions between actors. The implementation was also decentralised and run by organisations nominated by the local governments. While this programme had an impact, it remained unclear whether its potential has been reached, particularly in terms of HEI participation (OECD, 2013).

Even if the MEXT programme is now being terminated, it raised a number of interesting issues. During its operating period, many participating universities were willing to increase their project size and extend their cooperation to other HEI abroad, but they were lacking the funds to do so. In fact, each knowledge cluster only received, on average, an annual subsidy of EUR 3.9 million. Given the size of the Japanese economy, the financing by the central government was therefore relatively small. It was said by industrialists that for both programmes there should be fewer clusters targeted so as to avoid wearing the support by the authorities too thin. It was also stressed that sufficient funds needed to be channelled to the most dynamic clusters.

Another important issue at the time was the coordination between the two programmes to improve the use of HEI resources. If MEXT was focussing on universities and public institutes developing new technologies and METI supporting commercialisation, they had a common network approach that could lead to overlapping and duplication of tasks. The two programmes mainly developed in parallel, apart from information exchange and interactions during

conferences. However, a number of regional cluster promotion committees were set up. With regard to coordination, a pragmatic and case by case approach needed to prevail. For certain projects a unique supervision could have been more efficient, while for others it would have been more useful to maintain the double vision.

These three programmes have been selected, because they offer different solutions to cluster development and their adaptation to new competitive pressures. The analysis has identified a number of issues, notably the problem of the leadership of HEI and the possible need to improve it, notably in the French and Finnish cases. Different approaches have been followed such as entrepreneurial, broker-based and thematic/sectoral which have their merits. In most cases, however, they have resulted in the involvement of a large number of stakeholders. This has probably created important transaction costs, but nevertheless increased the opportunities to generate innovation. In the future, the cost of these programmes does not seem sustainable. It is perhaps less so for the Finnish programmes, though some regeneration costs will have to be covered in the future and it could be assumed that central governments will gradually phase out their contributions.

7. Coordination and synergies

The issue of the role of HEI in regional development is closely linked to the role that HEI play in decision-making and their ability to maximise regional impacts from the resources that they have. In many OECD countries, representatives of HEI have started to play a more visible role in regional economic policy-making. There is enhanced participation of academic staff in regional bodies and increased networking with regional governance institutions, i.e. regional agencies, regional development organisations, city and municipal development offices, planning commissions or local science councils. In the public programmes of some countries, the participation of HEI is mandatory on boards or in partnerships that manage economic development agencies. In most cases, the identification of regional needs by HEI takes place through supervisory and advisory boards which involve regional stakeholders and particular business representatives. However, the picture should not be painted too positively. Many HEI still behave as somehow passive assets or exhibit other preferences considering their national and international role as priorities. In certain cases, university managers would advise not to embark in regional affairs, because they fear this would give their institution a rather provincial and narrow image. Furthermore, in certain regions the relationship between HEI, local communities and notably cities, has remained rather weak.

HEI are nevertheless well placed to provide regions and communities with numerous services. They have the expertise to analyse future challenges from a multidisciplinary perspective and identify policy options and scenarios for

the future. They are a reservoir of ideas and innovations. As such, they can be valuable contributors to the economic development policy process. Some government programmes act as facilitator in that context (see Box 3.4). It remains that for certain communities and cities there might nevertheless be some reluctance to draw on the expertise of HEI in policy formulation. While foresight and visioning exercises are mainly used at national level, it has only started to trickle down to regions and subregions in some countries.

Box 3.4: The university centre programme

In the USA, the EDA (Economic Development Administration, US Department of Commerce) launched a University Centre Programme with the objective to create partnerships with HEI in order to improve the economies and economic development capacities of their service areas with emphasis on economically distressed communities. The programme funds proposals for a three-year period with most regional offices providing funding on a year-to-year basis depending on performance and the availability of funds. University Centre Projects provide management and technical assistance services to communities, counties, districts, non-profit development groups and technology transfer assistance to firms. The programme co-finances sixty-nine centres housed by universities in forty-five States and Puerto Rico with a budget of USD 7.7 million. A recent evaluation has examined a number of programme features, including centre effectiveness, distressed area targeting and utilisation of university resources.

Source: EDA, 2014.

Another aspect of governance is that of coordination among universities and promotion of a 'common HEI vision' for policymakers. While cooperation between universities, as well as between universities and other HEI and the polytechnics often allows the groups to reach critical mass and provide more diverse services, the intensity of collaboration remains nevertheless very uneven. Cooperation has thrived in some countries, such as the UK, leading to successful initiatives (see Box 3.5). Although competition for funds has sometimes slowed down the development of interuniversity collaborations, the trend has also been encouraged by central government measures, as well as by the awareness of the benefits that can be drawn from speaking with one voice to regional agencies. Some regions also have a longer history of collaboration among HEI actors or have good 'social capital'. However, in some other countries and regions, due to a lack of funding, weak interest and/or difficulty to agree on a clear division of labour, clustering of universities and cooperation with polytechnics are still limited. As emphasised in some case studies, connectivity often needs to be planned and the local or central government can lay the groundwork for such initiatives.

In certain countries, specific programmes have been designed to counter the fragmentation of the tertiary education system and as a consequence to remedy its weak ability to collaborate with the private sector. Experimental initiatives requiring some level of interuniversity cooperation have also been taken. In the EU, the Regions of Knowledge (ROK) programme is built on a pilot action introduced in the 2003 Community Budget by the European Parliament. It aims to promote research driven clusters associating universities, R&D centres, firms and regional authorities and to stimulate the integration of regions in Europe. While very modest at the start, its budget has been significantly increased. EU Member States earmarked a total of EUR 126 million for funding this theme over the duration of the 7th Framework Programme for Research and Technology (2007–2013). The ROK programme is now instrumental in supporting smart specialisation initiatives and the new EU 2020 innovation strategy.

Box 3.5: Knowledge House

Knowledge House (mid 1990s–2011) was a joint effort of the five universities in North East England: Durham, Newcastle, Northumbria, Sunderland and Teesside, along with the Open University in the North through the regional association of universities, i.e. the Universities for the North East (Unis4NE). Knowledge House operations were dispersed to individual universities in 2011 as a result of dismantling of the Regional Development Agencies and the Regional Association of Universities.

The idea behind Knowledge House was that SME face a range of barriers in accessing the knowledge resources of the universities which discouraged regional university/SME collaboration. Knowledge House was created specifically to overcome these barriers and to increase the amount of technology transfer taking place between local firms and universities. The purpose of the scheme was to create a structure which suited SME looking for help with a particular technical problem. The first barrier an SME faces in contacting a university in search of help, is the lack of knowledge of whom to contact. Therefore, Knowledge House offered the benefits of a single point of contact for all universities in the region.

Knowledge House could be accessed via a central node, based at a Regional Technology Centre or any of the five university nodes. The initial enquiry would then be sent out to contact people at each of the five regional universities, inviting them to suggest academics that could address the identified need. Each university had a coordinator responsible for ensuring that the leads are disseminated to the correct contacts. The network and its operations were supported by a web-based enquiry handling/project management and client relationship management system.

Ideally Knowledge House was able to offer the SME a choice of academic consultants and would facilitate a meeting for the managers to meet with and select the most appropriate person for their needs. Knowledge House helped companies access university skills, expertise and specialist resources. It offered expert solutions for developing ideas and solving problems through collaboration, consultancy, training and research.

Box 3.5: Knowledge House (Continued)

Knowledge House generated an income in excess of GBP 13 million for its universities from over 1 300 projects since 1996, with GBP 7.6 million of this from the last four years. The profile of Knowledge House rose significantly over time, with more than half (60%) of all enquiries generated since 2003. In 2007, Knowledge House generated GBP 4.7 million for the participating universities by delivering 364 completed projects from over 800 business enquiries. Business growth averaged 25% since 2000. In contrast to networks that provide only sign-posting services, Knowledge House offered a comprehensive service, stretching from the receipt and circulation of enquiries through project management and delivery to post-completion evaluation. It also played its part in the integration and consolidation of the business support services in the North East through formal agreements and joint appointments with other non-university business support agencies such as the Business Links Service and the Regional Development Agency. Knowledge House helped facilitate a cultural change within the academia, since an increasing number of HE staff across the universities in the region were becoming engaged with the activities of Knowledge House.

Source: Potts, G. 1998.

8. Areas for policy improvement and good practices

Overall, despite initiatives such as those mentioned in the preceding section, the role of tertiary education institutions in the economic arena is still highly variable even within the same country, suggesting that the potential is not being reached in many cases. Indeed, a number of questions remain insufficiently explored:

a. What are the best ways to promote HEI strategic approach in the region in order to make them more entrepreneurial and to provide a good basis for active engagement?

b. How to better promote partnerships between HEI, city agencies and regional development organisations?

c. How can government favour the elaboration of frameworks for the collaboration between universities and the business sector?

d. To what extent can central authorities help HEI balance their strategy between major regional engagement paths: supporting regional economic development strategies in particular commercialisation of research, inward investment and community-based linkages as well as promoting the output of HEI in terms of labour markets and skill initiatives?

e. What should be done to better coordinate or even reconcile initiatives taken by the different Ministries or Departments concerned by HEI regional engagement activities?

f. How to improve incentives and engage policy delivery?

These questions underline the relative lack of knowledge about the effectiveness of initiatives and policy measures designed to address these issues. They reflect more generally the present weaknesses of the policy assessment process with regard to regional engagement. Most policies are nevertheless in their infancy, with large scope for improvement and innovation.

So far the analysis suggests a number of lessons. This section elaborates on some of the questions posed above, indicates some good practices that seem to be of general relevance initiated by OECD member countries and give some recommendations.

8.1 Regional policy strategies and planning

As emphasised in OECD territorial reviews, engagement policies often lack clarity and act at the margin without very explicit regional dimensions. Such policies had mixed results in mobilising the non-entrepreneurial HEI given the low level of incentives and the modesty of funds invested. In addition these policies tend to be piecemeal and compartmentalised and they focus primarily on transfer of knowledge rather than taking a broader regional competitiveness approach. In other words, they are often technology-generation or transfer oriented.

The approach could be made more comprehensive and consistent if regional plans are set up and if they are elaborated as a shared task between governments, universities, research centres and the business sector. This should translate into better links between the HEI expertise and the strategic priorities of the region. It could also coalesce into various sectoral plans often designed at the regional level in technology, health, labour market and so forth. Some regions have initiated such approaches, but many are still inactive in that context.

These strategic plans should help to diagnose comparative advantages and to build vision based on dynamics of local and regional economies. They should be transparent with regard to the stakeholder's commitment. They should contribute to shape different HEI roles, including but not restricted to technology issues.

Universities often give insufficient priority and investment to activities that are not technology or R&D intensive, notably service related activities. Environmental management, tourism, transport services, culture, sport, leisure, etc. can offer new possibilities to HEI to develop joint activities with the business sector.

The related action plans need to be prepared specifying individual tasks, responsibilities, timelines, resources and performance measures if they are to drive the regional competitiveness agenda forward. They also need to be accountable and comprehensively evaluated on a regular basis.

8.1.1 Good practices

Strategy: The Twente Innovation Platform established by the province of Overrijssel and Network City Twente in the Netherlands, involves representatives from industry, local governments and major HEI contributing to the development of the region. It elaborates a vision for an innovative Twente region and publishes a delivery plan. It has identified key innovative actors and projects that could be harnessed to boost innovation in five key domain clusters. The delivery plan aligns funding from municipalities, the province and the Resource Description and Access (RDA). It is behind existing activities and should help to develop more projects of integrated multi agents across the five regional clusters.

Strategy prerequisite: building infrastructure for collaboration: In Denmark, in the wake of the local government reform, regional growth fora were established with representatives from the newly created regions, municipalities, local trade and industry, the institutions of education and research as well as the parties of the labour market. They are expected to monitor local and regional opportunities for growth and to formulate regional development business strategies, which can be fed into the development plans of the regional councils. However, the success of this reform and the fora depends on the financial resources that are devoted to the new regions and to their ability to influence national and local policy-making

Policy messages: Promote HEI not only as technical adviser for regional strategy-making, but also as an actor in the process and as a true stakeholder.

8.2 Role of cities and subnational governments

While much policy development in this field has involved national governments, there is important scope for action at the metro-regional level, which combines both the proximity at which detailed collaboration is easiest and sufficient scale to capture synergetic effect and diversity. Cities and city-regions have clear interests in supporting local HEI regional involvement. They benefit from the presence of a university, which represents not only a main asset, but could be a magnet to attract investment and talent. Flagship areas of expertise of local HEI can be highlighted by city authorities in branding their city as centres of entrepreneurship, innovation and creativity. City-regions/HEI partnerships are particularly fruitful in the following three domains:

8.2.1 Matching supply and demand in the local labour market

Metropolitan regions often face shortages of highly skilled workers, because of insufficient or maladjusted local skill supply or brain-drain. Cities can gather intelligence on educational needs and assess how these needs can be met within the tertiary sector institutions. They possess information, expertise and knowledge necessary to anticipate future skill demands. This intelligence often

supplied by local HEI is increasingly needed by the business sector that is willing to settle and expand locally. These demands are likely to amplify as city labour markets become more complex and the need for highly skilled workers more crucial.

8.2.2 Promoting local economic development

Cities and universities can jointly develop new models of decision-making which will increase economic competitiveness and reduce social exclusions. In some countries they have joined forces in order to develop programmes designed to improve the level of innovation within the economy and tackle urban regeneration issues. Universities have the potential to provide support, expert analysis and guidance for cities. In that context, universities can promote and assist in strengthening the decentralisation and devolution process and in developing important linkages with the broader city-region.

8.2.3 Contribution to regional systems of governance

Strategic coalitions and partnerships between urban research universities and the cities they serve is a good vehicle for sharing experience and providing common policy responses. These coalitions seek to make a positive difference in urban environments. They could also take the form of subregional alliances with communities and agencies to deliver economic, physical and social regeneration projects. To gain strength frameworks such as science cities help to link and reorganise research units and centres of excellence with regional industries.

While these initiatives have thrived in certain countries such as the USA, the UK and the Netherlands, it is to a lesser degree in others. In many regions there is still an important potential to be tapped to benefit from the synergetic effect that can emerge from city/HEI partnerships.

8.2.4 Good practices

Labour market plan: The city of Toronto prepared a Labour Force Readiness Plan for the period 2001–2010 in partnership with the business community, labour representatives, the education sector and all levels of government. The plan provided an overview of labour market issues in the city region and detailed action plans for three clusters. The labour market forecasts were prepared on the basis of disaggregated data by an expert team composed of local stakeholders including the University of Toronto.

Skill Enhancement Partnership*:* The Great Cities Universities Skill Enhancement Partnership Initiative (SEPI) in the USA, aims at creating a roadmap of educational and training programmes targeted at closing the gap of employees in the technology sector. Two London initiatives have similar objectives in the UK: The London Higher Education Consortium aims at creating a forum and

also at providing a body from which HE representatives can be drawn to serve London new agencies and boards. The second is the Thames Gateway London Partnerships: a subregional alliance of local authorities and universities, the London Development Agency designed to deliver with the private sector the socioeconomic regeneration of the Thames Gateway in London

Policy message: It is to establish more formal and operational partnerships between HEI, regional development organisations and city agencies. Experience in many countries, including the USA, shows that such agreements are the most effective.

8.3 Transfer of technology and commercialisation of academic research

Increasing the impact of publicly funded R&D on firms, particularly local firms, is a key objective for policies. Science and technology policies in most OECD countries have shifted to emphasise commercialisation of academic research and cooperation with the private sector and this is evident in the range of programmes that target HEI. A main vehicle for this R&D transfers has been the setting up of some type of TTO and/or TLO to help manage externalising their R&D work. However, HEI are not always well equipped to play this role. Many technology transfer centres are in urgent need of further finance and have problems with the management of it. The cost of research is often underestimated and the revenue generated often disappointing. These offices are furthermore not well connected with other transfer institutions.

Policies could be improved in three ways: First of all, it is important to bear in mind that internal arrangements within universities generally underpin their external governance mechanisms. This is an aspect of development that is often overlooked. Some universities might behave like ivory towers for the outside world and may be weak in joining up efforts across faculties and departments. University leaders need to make an effort to raise the levels of cooperation and joint working between traditional disciplines within HEI, if they are willing to embark onto collaboration with the private sector.

This will be all the more successful that staff, units and departments are able to renew their curricula and research programmes in order to reflect the needs of society and regions rather than being driven by disciplinary traditions and boundaries. An important facilitator would be to generalise efforts to widely diffuse the entrepreneurship culture. A lot of knowledge about entrepreneurship has been accumulated in academic institutions, but it often remains concentrated in a few departments.

Secondly, even if there is funding directed towards collaborative research, it is in general not focussed towards regional firms or linked with regional priorities. As OECD reviews have shown, only a minor share goes to the region apart from

a small number of cases. This problem might also emerge at the market end of the process since many regions are in short supply of risk-willing VC to finance academic-based endeavours. Recourse for private funds might not be easily available, because their objectives are to maximise the return on investments which in the case of seed and pre-seed VC is difficult to achieve in a relatively short term. In addition, these regional funds might be willing to finance spin-offs outside the region or the country since they are often perceived as more performance driven. Some regulatory framework is needed to ensure that a certain part of these funds is invested in local and regional spin-offs. Regional funds for precompetitive research as well as for VC would help to bridge the gap.

Thirdly, in the case of high-tech development, it is important that firms will be in a position to tap research capabilities at research universities in emerging fields with theoretical and practical potential as well as to encourage inter-university cooperation. In many metropolitan areas, the strategy shifts from assisting existing industries and forming new firms based on existing technologies to the more difficult task of firm formation from leading edge technologies, more closely tied to academic research. Specific programmes can be designed to encourage the development of technological platforms with the participation of local HEI. For technologies that fall outside the remit of these platforms, there might be a need for institutional innovation and specific brokers that could be supported by national and subnational governments.

8.3.1 Good practices

Fostering entrepreneurship: An increasing number of universities are currently making entrepreneurship and innovation part of their curricula in Denmark. National programmes are being operated in some countries such as the Entrepreneurship Academy in Denmark (IDEA), the largest entrepreneurial programme with interesting local impacts in Europe.

Establishing innovation regional funds: Announced in 2000, the Atlantic Innovation Fund (AIF) is a programme designed to strengthen the economy of Atlantic Canada by accelerating the development of knowledge-based industry. The AIF has proven to be a key catalyst in encouraging strong partnerships among businesses and the research community and notably HEI. Its objectives are:

a. To build capacity for innovation and R&D that leads to technologies, products, processes or services that contribute to economic growth in Atlantic Canada.

b. To increase the capacity for commercialisation of R&D output.

c. To strengthen the innovation capacity of the region by supporting research, development and commercialisation partnerships and alliances among private sector firms, universities, research institutions and other organisations in Atlantic Canada and maximise the ability to access national R&D funding programmes.

The AIF focuses on R&D projects in the area of strategic importance for the region including IT, ocean technologies, aquaculture, health and medical as well as environmental technologies.

Reallocating resources for highly developed research: A relatively inexpensive NSF programme in the USA, Industry/University Cooperative Research Centres (IUCR) brings together groups of firms in an industrial sector, typically located in the same region. Each firm contributes an amount of funds which is matched by government. These funds are pooled in a common pot and the representatives of the firms, together with professors from one or more universities, act as a club in deciding upon joint projects. This is carried out by professors and students sometimes with industry participation. Over time the firm contribution increases and the government contribution declines. A higher level, but more expensive version is the NSF Engineering Research Centres Programme which involves advanced training of PhD students. These centres have memberships and contributions, but research projects are more university led at the edge of technology where firms may not yet be developing products.

Policy message: Government at central and regional level should consider the desirable balance between research for longer term, new development and exploitative R&D for the use and dissemination of existing technologies. They develop more inter-institutional collaboration and partnerships of a complementary nature. Partnering with firms from the initial phase of R&D programmes considerably reinforces the innovation potential of academic research.

8.4 Bridging the gap

Intensifying the transfer of academic research to industry may be nevertheless a difficult goal to reach regions with low absorption capacities. SME are often the backbone of these regional economies. In these regions as well as in others, SME are notoriously difficult to access from universities with the exception of a few high-tech sectors. International experience suggests, nevertheless, that SME that have employees with a HE degree are more likely to have links with universities, using them as a source for technology upgrading, knowledge transfer and consultancy. Given that there are very few employees with HE pedigrees in SME, such careers are often perceived as unattractive for young university graduates. Many governments try to address this issue by paying some of the wages for academics wanting to work in a small firm.

These policies could be strengthened through actively supporting and promoting the collaboration between the different local HEI. Polytechnics, technical universities or community colleges have usually forged close relationships with SME, providing them with technical assistance, testing services and cooperation for incremental innovation. One way for universities to collaborate with small business would be to build consortia and cooperation with other HEI and propose piggybacking and complementary services to

those supplied by the polytechnics. This could be further reinforced through the creation of joint one-stop shops offering an integrated range of supply services to firms, emphasising in particular the relationship between market-based and less applied research. Mapping out and recognising HEI own strengths and knowledge fields would be useful. Synergies could be developed through joint projects and graduates' theses.

Another way would be to encourage HEI to enter and/or assume the leadership in regional networks. In some countries, forming regional networks is becoming a responsibility of HEI. There is, however, no external financial stimulus for HEI to embark in these networks. Some do it, because it has been a tradition for decades, others are lacking a budget for that purpose i.e. not only interacting, but also having a coordinating body between the parties to monitor the activities, results and communications thus often requiring substantial spending. Initiatives are sometimes developed in a fragmented way and are not transparent for the individual entrepreneurs. More focussed assistance seems needed to strengthen these higher education institutions-based networks.

8.4.1 Good practices

Joint strategies: In Finland, the MIC has requested HEI to jointly devise regional strategies for areas that are larger than a municipality or a county (maakunta). At the same time each regional council elaborates a four year regional programme for its maakunta. Though HE does not belong to the matters governed by the regional development legislation, the maakunta specific implementation plans list a number of expectations regarding universities and polytechnics.

Incentives: In the Netherlands, the main observation is that the quality of knowledge is good, but the utilisation of this knowledge within companies especially SME are not optimal. A number of initiatives have been taken both on a governmental level and in individual institutes, to improve the relations with the professional world. Knowledge vouchers have been a success and a lot of firms have been using these vouchers for buying knowledge from knowledge institutes. Another subsidy regime is linked with the policy to promote lectors and knowledge circles at *hogescholen*. Over 200 lectors have been appointed in a short period of time and one of their tasks is to create knowledge circles with relevant organisations. These networks of knowledge circles consist of companies and organisations in the work field. It is expected that these knowledge circles will strengthen contact between educational institutes and firms in the labour market.

Policy message: Stronger incentives for cooperative research seem crucial if HEI are to become active supporters of regional innovative networks. Providing funds to strengthen these networks and activate the knowledge transfer between the participants is in line with the internationally widespread acceptance of HE and research as public goods.

8.5 Contribution of teaching and learning to the labour market and the regional economy

While governments have rightfully pointed towards the need to focus on the R&D generated by academia, the development of academic spin-offs and HEI patenting, their approach has been sometimes unbalanced. Governments have tended to underestimate the role of existing informal links between HEI and businesses and sometimes neglected the role of teaching in engagement policies. Undergraduates and graduates are clearly a primary source of innovation in the organisations they join (Martin and Trudeau, 1998). As a consequence, one of the most important functions played by universities remains the education of graduates. In other words, it is crucial to consider the broader significance of labour market processes for the technological and organisational dynamism of regions.

A regionally engaged approach should first improve the demand orientation of HEI. For many regions and HEI, there is still a concern about the extent to which regional needs should be taken into account. It is difficult in particular to locate a formal mechanism to incorporate the request of regional industry in university curricula. In other cases, experiments and arrangements have nevertheless taken place. In certain regions/cities, universities have often organised panels to get input from competent users and customers in order to improve the relevance and quality of their programmes. Prospective employers are more willing to employ students following these curricula.

Apart from traditional full time courses, a growing number of students and companies are now interested in work-based learning as underlined above. Though increasing at a good pace, the absolute number of dual students in tertiary education is nevertheless still modest. There is therefore a need to intensify internship, cooperative education programmes and work placement.

Moreover, further education is important especially in less advanced regions. It helps to repair the educational deficit resulting from brain-drain and low education participation. Sometimes continuing education is provided by centres outside the universities funded by the municipalities and developed in conjunction with the region. Some type of coordination need to be achieved with the university programmes and courses on demand. HEI can be represented in the steering committee of the lifelong learning centres.

Also, in a number of countries such as continental Europe, the business sector is not much engaged in sponsoring university activities. It could be encouraged to do so with appropriate fiscal incentives. Although it is not a tradition in general, these incentives could induce some changes and make businesses more eager to obtain adjustments reflecting regional needs in HEI programmes. It could also help HEI face expected difficult budget perspectives.

8.5.1 Good practices

The new universities for regional innovation project (2004–2008): It was a major government funded project to strengthen the capability of South Korean colleges and universities located outside Seoul metropolitan area. The New Universities for Regional Innovation (NURI) project aimed to support equity by selecting and nurturing regional universities. Specifically, the NURI project aimed to develop college curricula in specialised areas which were closely aligned to characteristics of the regional economy. The project cultivated college graduates through various educational programmes reflecting the demands of the labour market as well as the needs of regional industries. Another purpose was to establish RIS in which HEI, local governments, research institutes and corporations build partnerships for mutual development and improvement. One hundred and thirteen universities including some two-year colleges were selected to conduct more than 140 programmes aligned to the characteristics of the regional economies. The programmes involved 181 833 students (about 10% of the total number of students) and 8 605 professors. The South Korean Ministry of Education and Human Resource development (MOEHR) provided USD 1.4 billion to the HEI in the NURI project during the period 2004–2008.

Policy message: It is necessary to vary and diversify the models of specialisation and to differentiate the different ways for a university to become specialised. The selection of specialised fields should be made with consideration of strategic alliances with institutions within and outside the region and taking into account the comparative advantages.

8.6 Policy coordination

Another major issue is the coherence of HEI regional engagement policies given the number of ministries and agencies involved. Even if, in many countries, regional development is becoming an issue at central level, Ministries in charge are too often still operating in silos. In addition, Ministries of Education in unitary states are often unconcerned by regional issues. The same could be said of Ministries of Industry which usually have strong sectoral biases. In most cases, no significant funding stream is allocated to support the third task of universities, even when the HEI regional mission is explicitly designated to university acts.

There are several options to enhance coordination between the sectoral ministries. First, some reorganisation could be undertaken giving more power and visibility to regional offices and sometimes leading to the creation of a regional directorate. Cooperation could be more easily organised on the basis of a more geographic architecture. Other types of organisations such as thematic restructuring are possible. Connections between ministries need to be regularly established i.e. through working parties and special committee meetings.

Secondly, joint projects and programmes between ministries should be encouraged even if they imply some type of transaction cost. They lead to collaborative decision-making and to common evaluation procedures and represent the best way for diffusing a cooperative culture between different units of public administration.

8.6.1 Good practices

More policy coherence is being achieved through improved vertical collaboration like the contractual approach and strategic interministerial committees such as the Finnish Science and Technology Committee chaired by the Prime Minister or the *Haut Conseil à la Science et à la Technologie* created in 2006 in France. These committees define broad orientation and the different ministries need to abide by their decisions.

Tension between national agencies and regional strategies could also be reduced through institutional restructuring. In that context the delivery system for the various instruments of industrial R&D and innovation policies need to be relatively straightforward. In Norway, they are gathered in a few institutions, namely the Research Council and Innovation Norway, both with regional offices and the Industrial Development Corporation of Norway (SIVA). Their visibility is good and the delivery system has become transparent after the merger of several agencies into a handful of one-stop shop agencies.

Policy message: More joint thinking between the Ministries dealing with education, research and regions is necessary to improve the coordination of policy interventions for regional engagement. Increasing the number of programmes involving the funding of these different ministries would help achieve this objective. In that context, an important step forward would be new national education policies in unitary countries that require universities to play a major role within regions.

8.7 Evaluation of regional engagement in higher education institutions

Monitoring the outcomes of engagement policies and assessing the impact of those policies would assist in dealing with above issues. In most countries, there is no formal process for reviewing the current engagement arrangements in the regions. It is usually restricted to scattered initiatives. In the UK, the central government assesses some aspects of regional involvement through HEIF annual reports and through the annual collection of data on business and community engagements. In Finland and Sweden, knowledge institutions have been mapped in certain regions, thus leading to some types of evaluation of knowledge infrastructure.

Nevertheless, there have been a number of evaluations and studies about limited aspects of regional engagement often identifying good practices. With regard to the policy support to technology transfer or creating networks, the evaluation of schemes generally refers to the number of business ideas screened and to the number of development products generated, but also stresses the need for complementary initiatives. In the case of university start-ups, incubators, science parks and indicators used, it includes the capacity of the programme to establish large partnerships and to access private funds, which are usually intended to take over public funds after a few years. The number of universities involved as well as firms and jobs created, are often quoted as elements of success. More sophisticated analysis, such as using questionnaires addressed to customers or cost benefit analysis of programmes, is scant. Evaluation practices seem more widely spread in some countries than in others as is the case in Germany, Finland, Sweden, UK or the USA.

8.7.1 Good practices

In the UK, the HE and Business Community Interaction Survey provides a number of indicators on research collaboration, consultancy, intellectual property exploitation, spin-off firms, study engagement and participation in regional partnerships. A survey published in 2005 noted an improvement in the quality of interaction between university and business. At that time, 89% of universities were offering a single point of enquiry for business and 79% were assisting SME to identify what resources they needed. An increase in job creations was the direct result of university spin-offs.

Policy message: There is a need for HEI to collectively construct an overall monitoring and evaluation system, covering all the regional development issues. This has to be supported by coherent and informative systems of indicators for the measurement of the regional contribution of HEI. The system should be able to gather information at the organisational level, the HEI level and the regional level.

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CHAPTER 4

INNOVATION POLICY

1. The case of Brazil: region and innovation policies

1.1 Introduction

Brazil is a huge country, nearly a continent. It includes six macro regions which consist of two well developed and urbanised core regions (South Coast and South), an underdeveloped problem region (North East) and three Centre West regions more 'recently' populated, with Brazilia and pioneering internal territories sometimes quasi empty (Amazonian basin, Centre West and North). This subcontinentality generates costs linked with distance and makes the management of vast areas difficult.

The country is also confronted with global challenges linked with the protection of environmentally degraded ecosystems and the preservation of a milieu with high biodiversity in the Amazon forest. Furthermore, Brazil needs to cope with considerable socioeconomic problems. It needs to face underdevelopment and extreme situations of inequality and among others high poverty, violence, analphabetism, short life expectancy and high infant mortality.

To face all these challenges, consolidate its economic dynamism, reduce unemployment and alleviate poverty, the country needs to increase growth and to diffuse it all over the country at the same time. To reach this objective, the country has relied mainly on FDI. This policy has been successful and the country has even captured a growing volume of FDI during the financial crisis (+30% in 2008). It has nevertheless led to a stronger polarisation of development in favour of the South and Southeast regions. More importantly FDI cannot be the only pillar of strategy, since it increased the dependency towards foreign technologies and expanded the gap with most developed countries and regions in the world.

The federal government has rebalanced the strategy over the last few years to give more weight to endogenous development and the stimulation of regional innovation capacities. It now intends to draw more benefits from the entrepreneurship potential and from the clustering capacities of SME in Brazil. It is presently redeploying and strengthening the support system to innovative firms and R&D spending to trigger off a catching-up process with other BRICS and the developed world. Within that approach, universities are called upon to invest more in research and to extend their collaboration with industrial firms and services.

1.2 Support to small industries

Microenterprises and small enterprises account for 99% of the 6.4 million Brazilian firms. To this figure it is necessary to add from 10 to 14 million informal enterprises, including the 4 million family farm businesses. SME and micro-enterprises employ about 16.2 million people which interpret as about 51.7% of private jobs (SEBRAE, 2013). Seventy-five percent of these firms are located in the South and Southeast regions.

SEBRAE is the Agency providing assistance to microenterprises and SME. This assistance takes the form of schemes to supply training and counselling services, to encourage the cooperation between firms, to boost the creation of networks and to enhance local development initiatives (see Box 4.1). The Agency also helps local governments.

Box 4.1: SEBRAE: The small and medium-sized enterprises agency

One task of SEBRAE is to assess clusters, supply chains and provide diagnosis. The Agency also aids local governments and can put the focus on actions for distressed urban areas. It funds consultants to help SME in a number of areas such as technological development, market penetration, credits and organisational structures as well as management. In all these different domains, the agency gives advice and help small business to answer calls to tender. It cooperates with Research and Projects Financing Agency (FINEP), the innovation agency of the Ministry for Science, Technology and Innovation, also with banks, industrial federations, local administrations and federated states. It offers evaluation of project assistance to universities and encourages student entrepreneurship.

Regional affiliates adjust their activities to the regional environment. The Rio de Janeiro agency is involved in a number of sectors: fashion, furniture, jewels, oil, gas and metal/mechanics. It takes part in domestic market events, like fairs and exhibitions or export operations like ready-made clothing. SEBRAE also participates in one-stop shop activities in certain municipalities, for instance in Petropolis, a location for a number of fashion companies, Foundation for Research and Development Support of Rio de Janeiro (FAPERJ) services, the mayor's administration, SEBRAE, the unions and the centre for services to enterprises as well as National Service for Industrial Training (SENAI) which translates as market prospection services, have been regrouped in a single building.

This agency has carried out actions aiming at detecting entrepreneurship abilities and aptitudes to work in textiles and garment industries in the *favelas* (shacks in Brazil). Each *favela* has set up an association that identifies individuals with the capacities to do sowing work. In Rio de Janeiro, 300 *favela* seamstresses now provide regular services. SEBRAE connect these associations with local and foreign fashion companies such as Lacroix or Lacoste in France. For those so-called social responsibility projects, participating firms can benefit from fiscal incentives.

Source: SEBRAE, 2013.

The Ministry of Industrial Development and Trade (MIDIC) has set up the local productive arrangements programme encompassing a development plan for micro-enterprises and another one for low or medium technology clusters supervised by a working group within the Ministry. The group has identified 950 Local Productive Systems (LPS) and prioritised 260 of those.

A methodology has been established to provide assistance to these LPS via twenty-seven networks of public and private services. Each of these LPS receives incentives if they elaborate a strategic plan based on the integration of enterprises and the cooperation of actors. Within the framework of a special aid programme, called Programme to Support Export (PESEX), LPS companies could be assisted with advice that help them solve technological, commercial and management problems with the view to increase productivity and foreign sales. MIDIC has also created a Competitiveness Forum and launched a Competitiveness Programme for supply chains.

The Ministry of National Integration (MNI) is also active in addressing priority territories following the National Policy for Regional Development (PNDR) and in reducing inequalities. One of its main instruments is the Promotion of the Sustainability of Subregional Areas (PROMESO) programme which aims to encourage cooperative efforts by local actors involved in clusters and supply chains. (See the territorial targets of this programme in Figure 4.1)

Most of the Brazilian clusters have emerged in rural regions: furniture clusters in Espirito Santo, Uba City, Minas Gerais and Serra Gaucha, Rio Grande do Sul; shoe clusters in Franca, Sao Paulo and Nova Serrana, Minas Gerais; textile and clothing clusters in Nova Friburgo, Rio de Janeiro and Campina Grande, Paraiba; ecological tourism clusters in Bonito, Mato Grosso do Sul, software clusters in Joinville, Santa Catarina and in Bahia, Pernambuco. There are also clusters in food processing especially for fruit production in Petrolina, Pernambuco, Juazeiro, Bahia and Mossoro Assu, Rio Grande do Norte or for soya production mainly around Barreiras, Bahia and Balsas, Maranhao and south of Piaui.

1.3 Federal initiatives for research, development and innovation

Firms, not only SME in Brazil, are ill-equipped to face innovation challenges and to invest in R&D activities (see Box 4.2). Only a third of firms with more than ten employees have embarked on this type of activities during the 2000s. If we consider only product innovations, the proportion will be significantly lower – around 6% during the same period. Sectors and subsequently regions with the highest share of large firms take the lion's share of investment in R&D spending.

Box 4.2: Brazil mixed performances in research and innovation

R&D intensity is still low in Brazil, about 1.16% of the GDP in 2010 i.e. less than other BRIC members, but higher than Portugal, Mexico, Poland or Argentina. The public sector accounts for about 54.75% and the enterprise sector accounts for only 30%. Firms invest 0.64% of their income in new products and processes including purchases of equipment. Human resources are a critical challenge for R&D. Investments are limited by the low number of researchers and few of them work for the private sector (11%). There are only 1.48 researchers for a 1 000 employees and 10.7% of university graduates have a diploma in science and engineering. Less than 8% of the twenty-five to sixty-four year population has graduated in HE while science and technology jobs account for 18.4% of total employment.

Nevertheless, Brazil is doing better in a number of fields. 0.31 Triadic patents per million inhabitants are deposited by Brazilians and are simultaneously registered in the USA, Japan and at the European Patent Office (EPO). This is similar to what is seen in India (0.4), but significantly lower than in South Africa (0.69), Russia (0.81) and China (1.37). Positive development can be noted on the side of fundamental research. The share of Brazil in scientific articles written in the world has reached 2.2% of the total in 2012 (ranking Brazil at thirteen on the list of countries), an increase of 86% compared to 2002. This increase is lower than those of China and South Korea during the same period, but it is similar to Portugal and Singapore. From 2002 to 2012 citations of Brazilian publications (over a two-year period) have also increased from 0.6% to 1.1% of the total, but internationalisation of Brazilian research measured by the proportion of publication of articles written in collaboration with foreigners has decreased in relative terms.

Source: Dubarle, P. & Woyessa, Y, 2016.

The federal government has been increasingly concerned by the necessity to focus on innovation spending since the start of the first period of presidency of Lula da Silva in 2002. The 2004 law on innovation eliminated a number of regulatory obstacles to the creation of enterprises by researchers. The 2005 law, the so-called good law (Lei do Bem), now allows firms to benefit from non-reimbursable subsidies within the framework of the programme of economic aids to innovation. These subsidies granted over the 2006–2011 period to about 800 firms (for 825 projects) amounted to around EUR 600 million. New fiscal incentives were adopted in Parliament in 2005 as well as new regulations for the share of IPR among enterprises, research centres and university institutions.

The federal government also strived to establish priorities for research. Under the Lula administration, energy, space aeronautics and health were selected as strategic sectors. In November 2007, the Ministry for Science Technology and Innovation (MCTI) launched an Action Plan for Science Technology and Innovation (PACTI) with twenty-one lines of action and eighty-eight initiatives.

A new national strategy that functioned from 2012–2015, called National Strategy for Science Technology and Innovation (ENCTI) was subsequently defined at the end of 2011 in continuity with PACTI. It is the aim of ENCTI to reduce the technology gap that separates Brazil from the developed countries. Its objectives also included the enlargement of the basis for environment sustainability, the development and consolidation of Brazil leadership on the natural knowledge economy, the alleviation of poverty and the reduction of regional and social inequalities. Public expenditures of federal government states and public companies for ENCTI nearly doubled PACTI expenditures reaching EUR 28 billion. New priorities such as security and defence, new science frontiers such as biotech and nano sciences, the promotion of green economy and innovation for social development have been added to the list.

In Brazil, the innovation policy mix is biased towards direct support to innovation. Fiscal incentives to R&D spending are less important in volume. Assistance is mainly channelled to firms by the National Fund for Science and Technology Development (FNDCT), a fund managed by the Research and Project Financing (FINEP) (see Box 4.3). This fund has been restructured at the beginning of the 2000s with the creation of sectoral funds[1] and the refocus of aid towards collaborative initiatives between industry and public research.

Firms targeted by these direct aids increased by about 60% during the 2000s, but the number of firms involved in innovation activities (3 425 in 2010) has not grown significantly in relative terms. The share of income devoted to innovative activities has slightly increased during the 2000s reaching 3%. Sectoral performances vary considerably, 68.9% for R&D services, 5.9% for IT and 3.3% for telecommunications.

Box 4.3: Innovation policy and institutional governance.

The Ministry for Science, Technology and Innovation (MCTI) and its armed wing FINEP are two institutions at the core of Brazil research and innovation policy. Within this framework the National Council for Science and Technology (CNPq) is playing an important role, because it supervises all public research institutes. It is also the agency for basic research. Another important entity is Brazilian Federal Agency for the Support and Evaluation of Graduate Education (CAPES), an offshoot of the Ministry of Education (MEC) in charge of funding the HE sector. In recent years the MIDIC has become more involved in innovation support. This Ministry is responsible for the design of industrial policy via its newly established Agency for Industrial Development (ABDI). The MEC also provides an administrative umbrella to INMETRO, the Metrologic institute and National Institute of Intellectual Property (INPI).

1 There are sixteen sectoral funds dealing with oil and gas, energy, water resources, transport, mines, agriculture, space, telecommunications, computers, industry and university cooperation, infrastructure, aeronautics, the Amazon region, biotech, health, river transport and ship buildings.

Box 4.3: Innovation policy and institutional governance (Continued)

FINEP operates in coordination with CNPq and implements MCTI policy. On the one hand CNPq channel subsidies to individual researchers and research groups. It also finances scholarships and grants for researchers participating in the innovation programmes of firms. On the other hand FINEP support Science, Technology and Innovation (STI) activities in firms and public as well as private PRO.

The coordination of innovation policy was the responsibility of the MCTI until the creation of the National Council for Industrial Development (CNDI) and ABDI in 2005. Priorities and programmes within those institutions are now coupled with those of the MCTI and compose the innovation policy of the government. Articulating the initiatives of MCTI and MIDIC is not easy, also MIDIC pressurising to play the leadership role for coordination has not been successful so far.

There are also vertical coordination issues between federal agencies and state governments. Federated state initiatives and federal support are designed separately, thus leading to strategy overlapping and fragmentation of financing mechanisms. A number of structures are nevertheless in place to improve intergovernmental coordination. It is the case with the Council of Science, Technology and Innovation Secretaries of State (CONSECTI), the National Council of State Research Agencies (CONFAP) and the National Council of Science and Technology (CCT), that operates at the level of the Presidency.

Given that it is still in its early stages, the innovation policy governance system is not yet stabilised. Some of its components are not very active and the mandate of several structures and councils is ill defined. In addition to this, there is a certain opacity in the links between them. Furthermore, the responsibilities of the different partners are not well established. Changes are to be expected in the management of the whole system as well as within the institutional map.

Source: Dubarle, P. & Woyessa, Y, 2016.

Government funding is directed for a large proportion (around two-thirds) towards public universities and public institutes rather than towards firms. The programmes targeting human capital accumulation and academic research include notably the funding of fifty-two federal HEI and of the CNPq and CAPES, which are the two federal agencies supporting post-doctoral research and the transfers to the Brazilian Agricultural Research Corporation (EMBRAPA). This focus on the public sector R&D is also a consequence of the weak inclination of the business sector for R&D and of the subsequent low number of researchers in the private sector, which resulted in about 17%, a figure significantly lower than the average of the OECD.

1.4 Decentralisation of innovation policy

In federal states like Brazil, states are important players in R&D funding and S&T policy design even if the most important part of the support to enterprises and R&D institutions is provided by the Federal Government. Federated states are totally autonomous for the elaboration and design of their science policies. Several of them have created their own funding agencies as well as HEI and Research Institutes. According to MCTI estimates about 35% of public R&D spending was financed by the federated states in the mid-2000s.

Sao Paulo State devotes the most important budget to research activities. It also receives the highest share of federal funds for R&D. Within that state, two-thirds of public funds for R&D come from the state budget itself and in particular the funds for the state universities and the nineteen research institutions. Sao Paulo State is the second most important investor in R&D in Latin America ahead of Mexico and Argentina. Other states are also active such as Rio de Janeiro, Minas Gerais and Rio Grande do Sul, even if their budgets are less important.

States are also often endowed with research foundations that help them to implement their policies. Examples of this include the Foundation for Research and Development Support of Sao Paulo (FAPEST), Foundation for Research and Development Support of Rio de Janeiro (FAPERJ) and Foundation for Research and Development Support of Minas Gerais (FAPEMIG). These Foundations, apart from FAPEST, are nevertheless underfunded. States need an innovation law in order to launch a regional version of the federal subsidy programme for innovation thus co-financed by State/Federation. In 2009 only seven of the states including the State of Amazonia, Santa Catarina and Mato Grosso had passed such a law. Now most of the states have caught up with these pioneers. They have established a legal framework that regulates activities and functions of state institutions for innovation support (OECD, 2013).

According to the Federal Pact (PACTI), STI national policy allocates a major share of its funds (around 30% and in certain cases 40%) to less developed regions of the North, North East and Centre West. This mechanism has been extended to peripheral zones of most advanced states. Within this framework most of the money goes to priority industries and strategic sectors. R&D infrastructures and certain elements of HE spending are receiving particular attention in the allocation process.

Funding institutions comply with MCTI guidelines, but some of them such as the National Bank for Social and Economic Development (BNDES)[2] also use

2 The Bank, created in 1952, plays a major role to back public and private investment. It is a main source of funding for large strategic projects in sectors such as hydroelectricity, heavy industries and automobile. BNDES has made a number of projects viable in less developed regions via advantageous financing conditions, moderate long term interest and long repayment periods. It is now also bolstering MCTI and FINEP efforts in the field of innovation.

their priority lists. Orientations for resource sectors i.e. electric energy and oil are not so clear, notably for the largest public firm: Petrobras.[3]

1.5 Science parks, entrepreneurship and technological start-ups

The increasing number of start-ups and technology-based small firms is somehow a new challenge. These firms are nevertheless not numerous and risk capital business complain about the limited opportunities offered to investors and the missing preparedness of new entrepreneurs especially in the high-tech domain.

To stimulate the birth of these enterprises, government often create scientific parks or technopoles to attract them and establish an enabling environment for their development. In Brazil, the Association for the Promotion of Innovative Organisations (ANPROTEC) has identified at this stage seventy-five technology parks initiatives (with twenty-five operational at the beginning of the 2010s). These parks tend to concentrate on a few regions. More than 70% of them are located in the South and South East regions. The North and North East regions have only one park each. According to ANPROTEC, parks specialise in the following activities: electronics, information technologies, biotech, energy, food processing and environment. More than 80% of these parks have formal links with universities and research institutions (60% public and 40% private).

More than 70% of federal funds for parks are destined to investment plans and feasibility studies. FINEP supported twenty-five parks through two competitive calls for projects in the last 5 years. In the most recent initiative in 2013, it was decided that FINEP will distribute non-refundable resources to the parks for USD 40 million and credits for US 220 million while USD 22 million was directed to the Innova Empresa Fund with the objective to back business operating in parks.

These businesses, especially the new ones, often benefit from services like coaching, expertise, mentorship and finance provided by incubators located in the parks. There are about 400 incubators all over the country, in parks or off parks, and they are host to about 6 300 firms. Parks are mainly real estate endeavours. They have also been set up in less advanced regions to retain graduates and keep human resources in universities, parks being in most cases an offshoot of HEI. In certain cases these parks have been established in the vicinity or around large state enterprise research centres like Telebras in Unicamp or Petrobras in Rio.

FINEP created its PRIME Programme endowed with EUR 496 million in 2008 to help start-ups in the scientific parks. Eighteen incubators received most

3 Large public enterprises, such as Telebras and Petrobras, account for 15% of the public R&D budget. The rest is mainly provided by FNDCT sectorial funds for 27%, BNDES for 18% and MCTI for 19%.

of this money. FINEP also nurtures the capital risk market via partnerships with the Inter-American Development Bank, SEBRAE, Pension funds and also ANPROTEC, Association for the Promotion of Brazilian Software Excellence (SOFTEX) and CNPq. BNDES is a player in some of these operations. It collaborates with FINEP for the creation of seed funds.

1.6 Higher education and the regional economies

To enlarge the industry basis and extend innovative services, federal authorities need to push the limits imposed by the education system and its lack of performance. Until now the access to education at all levels and particularly to HE is low. Only 7.6% of the eighteen to twenty-two year old population get an HE graduation.

The HE system is very diversified and dominated by private institutions that contributed to the recent expansion of educational supply in Brazil. There are 1 859 HE establishments in the country, 1 652 belong to the private sector and 207 to the public sector. Of these establishments, 40% are managed by the federal administration and 31% by the states. Remaining establishments (29%) are controlled by local governments. The 163 universities account for less than 9% of all HEI. Private institutions are mainly specialised in low cost management and humanities studies, thus preventing the rebalancing of qualifications towards scientific and engineering disciplines (OECD, 2006). Students who attend private post-secondary institutions score lower on standardised tests in general.

Research is mainly performed at public universities (ERAWATCH, 2011). According to the Scimago research classification, the most prestigious institution is the University of Sao Paulo (USP) that is ranked twelfth in the world for the volume of its publications (Scimago, 2012). Other important universities include the University of Campinas (UNICAMP) ranked at 160, Sao Paulo State University Julio de Mesquita Filho ranked at 162, Rio de Janeiro Federal University ranked at 196, Rio Grande do Sul Federal University ranked at 260 and the Federal University of Minas Gerais ranked at 306.

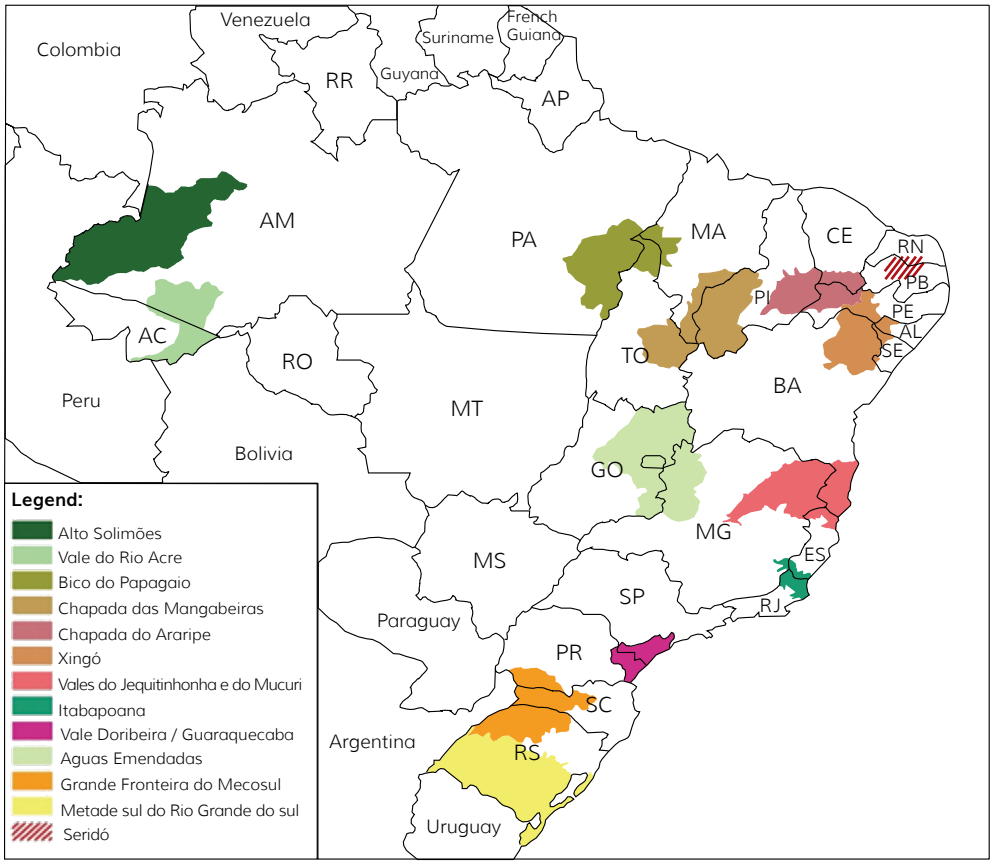
Collaboration between HEI and the private sector are not common place. Only 5% of university research and R&D conducted in public laboratories are financed by private enterprises (7.5% in the USA and 11% in Germany). The number of enterprises cooperating with universities has more than doubled at the end of the 2000s, increasing from 420 to 994. Most of these cooperation contracts come nevertheless from public enterprises and especially Petrobras. While 17% of firms collaborate with other firms and research centres in the EU, the corresponding figure is only 11% in Brazil (PINTEC and EIS data 2008).

Universities, especially in the South East, have considerably accelerated their patent activities. It is notably the case of UNICAMP and of the Federal University of Minas Gerais (UFMG). Unicamp is the first holder of patents in the country

ahead of Petrobras. It has set up an agency (INOVA) that aims to generate revenues linked with licenses and patents deposited by the university. These are mainly exclusive licenses since the licensee cooperate within the framework of an R&D contract signed with the university.

Recently another trend has been the steady development of Federal Centre for Technological Education (CEFET) i.e. technical colleges. They have mainly expanded in the South on the basis of the *fachhochschulen* model given the local influence of German immigrants.

Figure 4.1: Differentiated Meso regions in Brazil[4]



Source: European Union, 2008.

4 The twenty-six Brazil states include Acre (AC), Alagoas (AL), Amazonas (AM), Amapá (AP), Bahia (BA), Ceará (CE), the District Fédéral (DF), Espírito Santo (ES), Goiás (GO), Maranhão (MA), Minas Gerais (MG), Mato Grosso do Sul (MS), Mato Grosso (MT), Pará (PA), Paraíba (PB), Pernambouc (PE), Piauí (PI), Paraná (PR), Rio de Janeiro (RJ), Rio Grande do Norte (RN), Rondônia (RO), Roraima (RR), Rio Grande do Sul (RS), Santa Catarina (SC), Sergipe (SE), São Paulo (SP) and Tocantins (TO).

1.7 Conclusions

In the wake of its return to macroeconomic stability in the early 2000s, Brazil started to elaborate innovation policies and gradually started to strengthen them. These policies were instrumental in securing the growth performance in that decade, around 3.6% on average.[5] They did not remove a number of obstacles in the long term development of Brazil such as the shortage of skilled labour in many industries, the slowdown or even decline in productivity trends, the weak intensity of innovation and the modest R&D investments in a large majority of firms.

Furthermore, innovation policies have benefitted most developed regions and did not correct regional inequalities. FDI has not been eroded by the financial crisis and remains heavily concentrated in the South and South East regions. The national system of innovation is largely biased towards these states. The concentration of scientific parks and universities also confirm these trends. The country could certainly do more to channel resources to lagging regions.

Recently, progress has been made to improve the synchronisation between production development and innovation policies. Both policies increasingly take into account the territorial impact of sectoral strategies. The governance structure of these policies has been improved by emphasising coordination in the agenda of the Ministries (OECD, 2013). Despite governance arrangements and effort to articulate large scale strategies such as National Production Development Policy (PDP), programmes have had the tendency to proliferate and fragmentation of policies to persist.

2. The case of Egypt: Barriers to innovation – trends, issues and policy responses

2.1 Introduction

Lately, Egypt has encountered a few major shocks: the world financial crisis, a revolution following the Tahrir events and the so-called Arab spring. The economy has slowed down dramatically and a number of sectors such as tourism or the export sector is depressed. In this context of financial difficulties, policymakers are looking for ways to revitalise the private sector and reactivate public services. Among scientists, politicians and business circles there is increasingly the idea that encouraging science and innovation is one of the best ways to stir up a country that has stagnated for over thirty years. This section strives to assess the main barriers that hamper the development of innovation in the country and analyse government efforts to overcome them.

5 The rate of growth culminated in 2010 with 7.5% in Brazil.

2.2 Context and framework conditions

Egypt is the third most populous country in Africa with 83 million people and the second most populous in the Middle East. The economy is dependent on a few sectors such as agriculture, hydrocarbons and manufacturing as well as tourism. Productivity, GDP/capita and standard of living are low in comparison to the world standard. Oil and gas are major sources of export earnings. Tourism accounts for 20% of foreign currency revenues. The country has attracted FDI in oil and gas, but little R&D from multinationals. Obstacles to FDI include incomplete, incoherent and overlapping legislation, unstable exchange rate and shortage of skills (Niosi, 2009). FDI represented 1% of GDP in 2004, 4.4% in 2005, 5.7% in 2006 and 8.5% in 2007 which is 50% of the capital formation of the country.

The science and technology expenditures are very low, about 0.3% as a percentage of GDP and it has fallen recently. Most firms are conducting very little research and it hampers their capacity to absorb knowledge and technology from foreign firms. The need to reform this area was a subject of consensus at the time of the former administration, but there was not sufficient means to do it. At the time there was a divergence between the rhetoric and the policy implementation.

The main component of the R&D and innovation system is the universities where 73% of the research of the country occurs.[6] The twelve universities are host to 116 research laboratories. In addition, there are seventy R&D centres in the country. National Research Centre (NRC) is the largest institution with 60% of all research personnel of the Ministry of Higher Education and Scientific Research (MHESR) with 106 departments and 4 300 researchers. Six centres are autonomous: the Central Metallurgical Research Institute, the Electronics Research Institute, the National Institute for Standard, the Petroleum Research Institute, the Ophthalmology Research Institute and the Theodor Bilhasz Institute. Atomic Energy Authority employs more than 1 400 scientists. Several science and technology parks have emerged including the City of Scientific Research and Technology Applications (MUCSAT) which comprises of ICT, Biotech, Advanced engineering and nanotech, Smart Village around Cairo emphasising mainly ICT, as well as Sinaï Technology Valley, located at the northwestern access of the Sinaï Peninsula, focussing also on biotech, microelectronics and materials.

The Science Research budget for 2011 was around 89 million Egyptian pound. This has not increased since 2007 and accounts for 0.23% of Egypt GDP. The central government accounts for most of the R&D (86.18%), while the foreign sector executes only 10.6% and the private sector even less at 3.6% of the GERD.

6 As declared by Maged Al Sherbiny, former president of the ASRT.

2.3 Potential and challenges

2.3.1 Higher education

By 2000 Egypt had 1.5 million students and twelve state universities with eight branches. Nine private universities were host to 6 000 students with an additional 4 000 in the American University in Cairo (AUC). Graduations are at a low level. Universities produced 140 000 graduates in 1998–1999. Egypt spent less in education than most Arab countries and the ratio of students to professors (37/1) is high. Oil rich countries have attracted some of the best talents. Low salaries push professors to consult, teach private courses, sell books and reduce research.

Universities are ranked according to their publication output as seen in column 3. CxD in column 4 is an indicator showing the average scientific impact of the publication output of the institution in terms of citations per document. Column 5 shows the output ratio that has been produced in collaboration with foreign institutions. Column 6 shows the journal average importance where an institution output is published. Column 7 reveals the ratio between the average scientific impact of an institution and the world average impact of publications of the same time frame and subject area.

Table 4.1: Ranking of main universities in Egypt (Scimago International Classification, 2012)

Rank	University	Research output	CxD citations	International cooperation	Journal average importance	Field normalised Cit. score
357	Hacettepe (Turkey)	6135	3.71	20	1.02	0.77
427	Ankara	5208	3.06	18.63	1	0.63
506	Gazi (Ankara)	4405	2.88	11.69	1	0.65
592	Cairo	3809	2.84	31.58	0.95	0,67
604	Istanbul	3725	3.76	17.07	1	0.68
910	Ain Shams	2295	2.85	32.03	0.96	0.61
1001	Mansoura	1981	3.91	33.08	0.99	0.81
1014	Alexandria	1156	3.15	36.81	0.96	0.84
1159	America Beyrouth	1538	3.67	44.86	0.99	0.89
1178	Jordan (of S&T)	1499	2.61	31.35	0.99	0.64
1344	Assiout	1186	3.14	38.36	0.91	0.63

Rank	University	Research output	CxD citations	International cooperation	Journal average importance	Field normalised Cit. score
1366	NRC	1149	2.58	21.41	0.98	0.57
1530	Zangazig	893	1.88	27.55	0.96	0.48
1609	Tanta	781	3.75	39.31	0.99	0.81
1631	Suez Canal	763	3.1	44.04	0.98	0.76
1855	Helwan	559	1.69	31.48	0.9	0.5
1901	Al Azhar	518	3.26	34.17	0.98	0.69
1966	Menoufia	475	2.22	22.95	0.94	0.84

The best Egyptian universities notably Cairo University and Ain Shams exhibit a relatively good score in publications. The Scimago International Classification places them at ranks that are not too remote from the Turkish universities (see Table 4.1). The quality of the research conducted in Mansourah, Tanta, Al Ahzar Assiout and Suez Canal University is also similar to what is being achieved at the American University of Beyrouth or in good Turkish universities. Moreover, the collaboration with foreign institutions is more active in most of the Egyptian HEI than in their Turkish counterparts.

All in all the amount of research accumulated in these institutions is quite significant. A study of the Science Age Society (SAS) found that in the last twenty years 49 853 PhD theses have been written by Egyptians including 2 898 theses from outside Egypt. The question is now raised of assessing the benefits gained against their costs. About 75% of Egyptian researchers do their work in an academic context to obtain a PhD against 15% in the USA.

2.3.2 Industry

Another issue has to do with the contribution of the Egyptian industry to the knowledge economy and the generation of innovation. Modernisation of Egyptian industry is essential for quality improvement of products in order to provide a stronger competition within the world economy. Besides, an atmosphere suitable for industrial and commercial activities, it is necessary to encourage the private sector in assuming the main role in achieving economic development.

The industrial structure in Egypt is based on seven industries representing 80% of the industrial facilities. The top industries include textiles, food and beverages. Furniture, minerals, chemicals and metallurgy are also major industries. In 2005, it was remarkable that the engineering, electronic and electric industries came first with 30% of the industrial production volume. The

tobacco, food and beverage sector was ranked second with 23% followed by the chemical industries with 15% and the weaving and spinning, clothing and leather products with 10%.

Most Egyptian firms have little or no interest towards innovation. Only 18.8% of Egyptian companies are involved in innovative activities (according to a representative sample – see Fraunhofer Society, 2010). Moreover, most of these activities represent the acquisition of new machinery, equipment and software (83.7%) rather than new products and new processes.

The Egyptian innovation survey interestingly shows that performances between regions vary considerably. The governorates of Beni Suef and Monoufia are clearly identified as the innovation leaders while Qena and Assiout stand at a very low level. Cairo and Giza that are hosts to the greatest number of companies exhibit average performances. (see Table 4.2 and map of Egypt in Figure 4.1).

Table 4.2: Ratio of innovation-active enterprises per region (Egyptian National Innovation Indicators Survey)

Beni Suef	42.8%	Menya	17%
Monoufia	38.3%	Red Sea	16.6%
Kaliobiya	27.9%	Damietta	14.6%
South Sinaï	27.8%	Alexandria	12.1%
Gharbia	25.2%	Sohag	10%
Cairo	20.0%	Qena	4.5%
Giza	19.7%	Assiout	4.0%
Sharkia	17.3%		

Source: Egyptian Ministry of Scientific Research, 2009.

Despite the ongoing reforms, the economy is nevertheless still hampered by government intervention, substantial subsidies for food, housing and energy as well as bloated public sector payrolls. Moreover, the public sector still controls most of the heavy industry.

2.4 Recent trends

Egyptian competitiveness remains fragile. If we refer to the World Economic Forum (WEF) ranking, Egypt is ranked at 119 out of 144 nations (see Table 1.1). It stepped back twenty-five places in the global ranking when comparing the result in 2014/2015 to 2011/2012. Lower ranking was registered for quantity of HE, because of declining enrolment rate in tertiary education at the end of the 2000s. Moreover, the country is still among the worst performers in terms

of quality of education where it is ranked at 141. Critical factors for human development such as quality of HE, management of schools, the teaching of science and maths as well as the extent of staff training continue to be obstacles for greater competitiveness. Disparities in university access and results of tertiary education vary which means that regional income and the issue of access need to be urgently addressed.

Egypt is also underperforming in technological readiness, this measures the ability with which an economy adopts existing and state-of-the-art technologies to enhance the productivity of its industries. Several indicators are in the black, notably FDI and technology transfer, technology absorption and availability of technologies. Some progress was nevertheless achieved for the number of internet users.

For innovation, the position of Egypt deteriorated tremendously from sixty-seven in 2008/2009 to 124 in 2014/2015. Egypt, in particular, retreated in utility patents, availability of scientists and engineers, government procurement of advanced technology product and industry/university research collaboration.

2.5 Removing obstacles to innovation

To enhance its competitiveness and create employment, the Egyptian economy needs to make better use of its research assets and to overcome a number of barriers to boost its innovation capacities. So far more than four-fifths of Egyptian indigenous research is done in the HE and public research sector. Eliminating the obstacles to the transformation of this potential in new products and processes is therefore crucial.

2.5.1 Transfer of technologies

In 2002, Egypt has set up Technology Transfer and Innovation Centres (TTIC) to promote technology-based industrial development. The TTIC are intended to help businesses improve quality and competitiveness by aiding their adoption of new technologies and by creating conditions that promote innovation. They are also organised to test products, help Egyptian companies find strategic partners, provide professional training and development as well as grants to SME. [7]

TTIC can be considered as sectorally, subsectorally or horizontally operating centres. Nine TTIC serve certain industries including ready-made garments, leatherware and textiles, plastics and engineering, traditional industries, food furniture and marble and granite. A few other centres have cross-sectional foci e.g. clean production. All of them are co-funded by foreign donors.

7 Provided by the Ministry of Industry and Foreign Trade and international funding organisations.

The centres are designed to increase access to R&D by producing a directory of business-related information about technologies available worldwide, identifying those suited to local conditions. The TTIC then mediate with companies overseas that own relevant technologies with the aim of transferring them to local companies under licence.

So far, there is no clear intellectual property ownership and revenue sharing policy in place. When it comes to intellectual property, TTIC currently solve the industry problems they face through implementing foreign solutions. Accordingly, they require owning any IP that results from those implementations. In case they want to implement a solution whose IP is owned by a researcher, they require an exclusive license to that IP in order to be able to apply the same solution to all their industrial partners without restrictions (STDF, 2012).

One big problem is that TTIC only transfer technologies to the Egyptian industry from technology partners outside Egypt. Those partners are entities selling high-end products, licensing their patented technologies or selling knowledge in the form of training and consultancy. TTIC do not yet work on transferring technologies from the Egyptian universities and research centres to their industrial partners.

There might be some relationship with universities, but they are very few and based on historical foundations. Alexandria University, the Centre for Metallurgical Research and Development (CMRD) and Cairo University engage in common development and engineering projects. Relations with TTOs are not easy.

The existing TTOs, especially those established in public universities, are still not ready to perform their tasks effectively. They lack resources and expertise, they need to hire experts, receive more training, develop their strategy, agree with their universities on clear roadmaps and procedures as well as develop sustainable business models.

2.5.2 Entrepreneurship and spin-offs

TTIC offer technology incubation in five centres: fashion, plastic, jewellery, engineering and leather. Entrepreneurs are offered office space, technical assistance, mentorship and access to the equipment centres for a period up to two years.

Incubated teams have to bring their own materials and bear their own salaries and expenses. TTIC are currently looking for partners with previous experience in establishing and managing incubators to advise them regarding the best business model for running technology incubators.

The incubator potential is nevertheless limited. Most of them lack the required expertise, business models and efficient networks of stakeholders. ICT incubators show some success stories with a relatively structured business

model, experienced personnel and good stakeholders' network compared to other technology incubators.

However, they still need more training and experience in issues related to management such as mentorship and training, incubator finance, leveraging stakeholders' networks, tracking and graduating companies as well as intellectual property management. Moreover, the number of ICT incubators is very limited.

Box 4.4: Egyptian incubators

The Egyptian incubator programme was launched in 1995 by the Social Fund for Development (SFD), the World Bank and the Egyptian Incubator Association (EIA). The EIA has launched a pilot project for business and technology incubators, although its focus is more on employment generation than innovation. It provides technical assistance in setting up the incubators. The EIA also serves as a representative body for the incubators.

There are currently seven operating incubators run by the SFD: Tala Generic Business incubator – Menoufiya Governorate; Mansoura Generic Business incubator – Dakahliya Governorate; Assiut Technology incubator – Assiut Governorate; Tebbine Technology incubator – Metallurgical Institute – Cairo Governorate; Douwaika Virtual incubator – Cairo Governorate; Port Said Virtual incubator – Port Said Governorate; New Tebah Business incubator – Luxor Governorate.

The Ministry of Trade and Industry, through its TTIC network, also hosts business and technology incubators that offer entrepreneurs a wide range of services including technological support, technical assistance, advice and mentoring. The advantage of being linked to the TTIC with direct access to the facilities within TTIC premises i.e. machinery and being able to use existing market channels to promote projects.

Finally, a third type of incubation is offered in Egypt through the Small Industries Development Tabbin Technology Incubator, which is sponsored through the SFD. This programme is set up with an exit strategy, where firms are expected to attain financial sustainability after two to four years. The aim is to give technologically oriented small-sized firms access to a physical space, to technical and consultancy services, to research centres and to laboratories as the case is with industrial pollution monitoring facilities.

Source: OECD, 2015.

Specialised incubators are often underperforming. The current specialised technology incubators are managed by the SFD and the TTIC. However, SFD does not really share risks with entrepreneurs. They rent their incubation space, finance projects by loans with interest, do not provide any equipment and do not provide efficient training focused on entrepreneurship and intellectual property. On the other hand, TTIC still do not have clear models in place to

manage their incubators. They lack knowledge and expertise in incubator management (STDF, 2012).

Another barrier to the dissemination of innovation is the lack of formal education and training courses in entrepreneurship, incubator management and innovation management. There are exceptions such as the German University in Cairo (GUC) that offers an innovation management major under its business school. This programme is nevertheless not available for graduate students, non-business GUC students and those who cannot afford the GUC fees.

Last, but not the least, innovation funding is perceived by entrepreneurs as a major hindrance to innovation (Egyptian National Innovation survey, 2009). Investing in innovative ideas at early stages is very risky for private investors. Almost all VC in Egypt, who invest in high risk projects at early stages, do not get involved until they see a working prototype or a proof of concept. Some of them have recently established what is called 'Acceleration Programmes' to provide seed fund and mentorship to entrepreneurs whose ideas have growth potential.

The Egyptian Government is also promoting its equity fund. A VC committee was established by the Ministry of Finance in 2004 and the project for a government fund targeting SME is well advanced. Nine PE funds already operate in Egypt, but less than 10% of their funding goes to SME.

Some VC firms provide seed funds for start-ups working in the Information and Communication Technology (ICT) industry. Examples of these firms include Ideavelopers[8] and Sawari Ventures who invest in start-ups that prove their high growth potential and that have working concepts or prototypes in place. In return, they own equity in those start-ups. Although seed funds are available to ICT innovations, they are not enough to support all such innovations in Egypt. Moreover, there are no seed funds available for inventors willing to start-up companies based on non-ICT inventions.

2.5.3 Collaborative projects and academia industry cooperation

Collaboration between university and industry is not a natural process. A first obstacle is the insufficient preparation of universities to engage in collaboration and manage technology. Less than 50% of the universities applied for patents or licenses within the last decade. This indicates that most of the research

8 Ideavelopers is an integrated finance venture, development and incubation firm that partners with technology entrepreneurs. Ideavelopers manages and advises technology-driven funds worth in excess of USD 113 million of invested capital. These include the Technology Development Fund I and II, Middle East Technology Fund (METF), Jordan Technology Fund (JTF) and technology investments of the Commercial International Investment Company (CIIC). Since 2001, Ideavelopers has participated in the funding of some forty technology driven companies on behalf of its investment partnerships.

results of both universities and research institutes do not achieve an advanced status. A technology that is not mature enough to be commercialised may not achieve the performance objectives or goals set for the demonstration and thus can barely be transferred to industry.

Secondly, the lack of incentive and rewards to cooperate with firms act as a deterrent for industry/university collaboration. Credits for a scientific career can only be gained through classical scientific activities like publishing papers and teaching not through internships in companies or consulting for companies for applied research or development support.

Furthermore, the university agencies for private consulting reportedly are not financially attractive enough for university researchers to engage in joint projects with industry. In addition to the university management, the decision to embark in services to firms, establishing TTOs and undertaking patenting and licensing activities is not easy, all the more as national (or regional authorities) put the HE sector under significant pressure to increase efficiency and cut costs.

Thirdly, TTOs are not devoting serious efforts to communicate the industry requirements to the research community or to bring both communities to the same table to discuss the industry needs and the available inventions that might fulfil those needs. One of the main roles of the five operating TTOs is to establish links between the industry and the academic community and almost all the links established by them with the industrial entities are for the sake of commercialising the inventions that they currently have in hand rather than establishing a link for future collaborative research between the industry and the academia.

On the industry side there is a lack of understanding of the nature and relevance of the research that is being undertaken by the universities. As a consequence Egyptian businesses are not seeing local universities and research institutes as valuable partners for innovation activities. Inquiries show that more than 90% of the Egyptian businesses are neither using universities, technical institutes, governmental research institutes nor public research institutes as a source of information.

Another problem is the low efficiency of the cooperation process. While the relation between and academia remains wide-ranging, in a lot of areas it often does not translate into concrete results. A relatively important number of HEI are cooperating with the industry for training and qualification of staff. Cooperating with industry for joint research projects can also be frequent in certain technology segment. Unfortunately, the cooperation rarely leads to follow-up orders or joint product development (Fraunhofer Society, 2010) due to the lack of trust regarding competencies and the provision of useful products and services.

Furthermore, there is still a lack of project structures and a lack of cooperation between different units hindering interdisciplinary knowledge transfer and therefore hindering innovation. Only 63% of Egyptian research institutes are engaged in the development phase of the innovation process and even less – 54% – in the final industrial realisation phase.

2.6 Innovation policy responses

The Egyptian Research Development and Innovation System has many of the salient features that are common to other low to middle income countries in the region and around the world: lack of a well-defined strategy, dispersion of Research, Development and Innovation (RDI) initiatives among many RDI centres and institutes, inadequate funding levels, overall weak capacity for basic science research and poor RDI management (OECD, 2010).

Lately, major changes have been introduced to modernise the policy of the government, attempting to better tackle the RDI weaknesses and trying to eliminate a number of barriers to innovation, particularly addressing the issues that will be discussed hereafter.

2.6.1 Shortage of financial resources and access to finance

Public funding of science and technology has significantly grown lately. The Science and Technology Development Fund (STDF) now provides funds to RDI initiatives on a competitive basis. STDF also collaborates with Industrial Modernisation Centre (IMC) and provides targeted grants to industry in this context.[9] This represents additional funding that is projected to ensure the doubling of the R&D performance in Egypt in terms of percentage GDP. All the research centres affiliated to different ministries will be gathered under the Supreme Council of Research Centres and the scientific research budget is likely to grow with a government target of 1% of GDP to be spent on science.

Increasing support is also gained from foreign contribution. A new RDI programme was launched in 2007 with a grant of EUR 11 million from the EU. The programme endeavours to help Egypt to bridge the gap between the RDI system and industry and to increase the participation of the country to the European Research Area (ERA). The programme has three components:

a. The EU Egypt innovation fund (EEIF) that supports innovation projects Egypt/EU cooperation in technology transfer.

9 Three programmes are concerned: one on scientific R&D, another one that is designed to engage academics into specific assignments in factory (professor for factory programme) and one that aims at funding industrial prototypes. It also supports young researchers through specific grants and covers the patent applications and maintenance fees for IP generated from its funded projects.

b. The RDI network of focal points in universities to promote the participation of Egyptian RDI workers in EU funded programmes.

c. Policies for monitoring and evaluation of RDI initiatives.

2.6.2 Shortage in skills in research and innovation management

The government is also taking step for human resources development through international scientific interaction and reducing the brain-drain by providing the necessary requirements for people to stay and continue to work in Egypt. It has promised up to 50 000 new jobs in industry for young researchers, mainly to help with practical projects in the private sector.

The government can also capitalise on an already long list of existing policy initiatives, including the NRC 'Road to Nobel' programme to promote brain-gain, the Academy of Scientific Research and Technology (ASRT) Transfer of Knowledge through Expatriate Nationals programme designed to reverse the brain-drain and engage its expatriate scientists and the STDF Reintegration Grant, that pursues similar objectives.[10] Specific efforts also target young researchers.

2.6.3 Weaknesses in networking and cooperation with external parties

Collaborative activities in Science Technology and Innovation have mainly taken place within the framework of bilateral agreements with European countries or the USA or of the EU/Egypt cooperation. In that context the EEIF fund has encouraged the setting up of consortiums that consists of at least one partner from industry and one from the university or the public research sector.

Egypt has been very active and dynamic in ICT cooperative activities. R&D Centres of Excellence have been created within the MCIT (Ministry of Communications and Information Technology), on the basis of the consortium mechanism emphasised above. These Centres have been instrumental in setting up mechanisms for collaboration between academic and industrial institutions at local and international levels. The TIEC (Technology Innovation and Entrepreneurship Centre) also finances the development of internship agreements with multinational companies to train ICT engineers and university graduates.

The government has now started a process to establish a network of universities and research centres that will collaborate with the planned USD 2 billion science city (Zewail City). The aim of the network is to be a locomotive of economic and social development in the country. The Zewail City network will

10 STDF provides a fund of three years that would allow the Researcher to be 'reintegrated' in the Egyptian S&T community. He or she will receive a grant of EGP 750 000 (approximately EUR 100 000) and will be offered the opportunity to work in a well-established laboratory and to continue his/her research in Egypt.

link with research centres affiliated with both the MHESR and other ministries. The National Research Centre, the Nanotechnology Research Centre at Cairo University, the Urology and Nephrology Centre at Mansoura University, which is working on stem cell research, and the Aswan Heart Centre would be among the first to join the network as they fit the work that the science city will prioritise. The science city will include a university, a graduate research institution, a technology park to develop students' innovations and a unit to link science with industry.

Box 4.5: The basics of research, development and innovation policy in Egypt

Egypt has modernised its innovation policy in the last 5 years and notably implemented measures to stimulate investment, VC, business incubators, better quality education, SME development and entrepreneurship. Until recently there was no formal coordinating body in charge of innovation policy. It was delivered via the programmes of the relevant ministries which are often implemented with assistance from donor organisations. An important point of reference was the SFD that finances business centres and incubators, the Industrial Modernisation Programme and General Authority for Investment (GAFI).

Major changes took place in 2007. A structural reform for the R&D sector was passed in Parliament. A Supreme Council for Science and Technology chaired by the Prime Minister was created. Most functions of the ASRT with regards to grant-giving were transferred to a new granting Agency: the Science and Technology Development Fund (STDF) to support the Egyptian innovation capabilities.

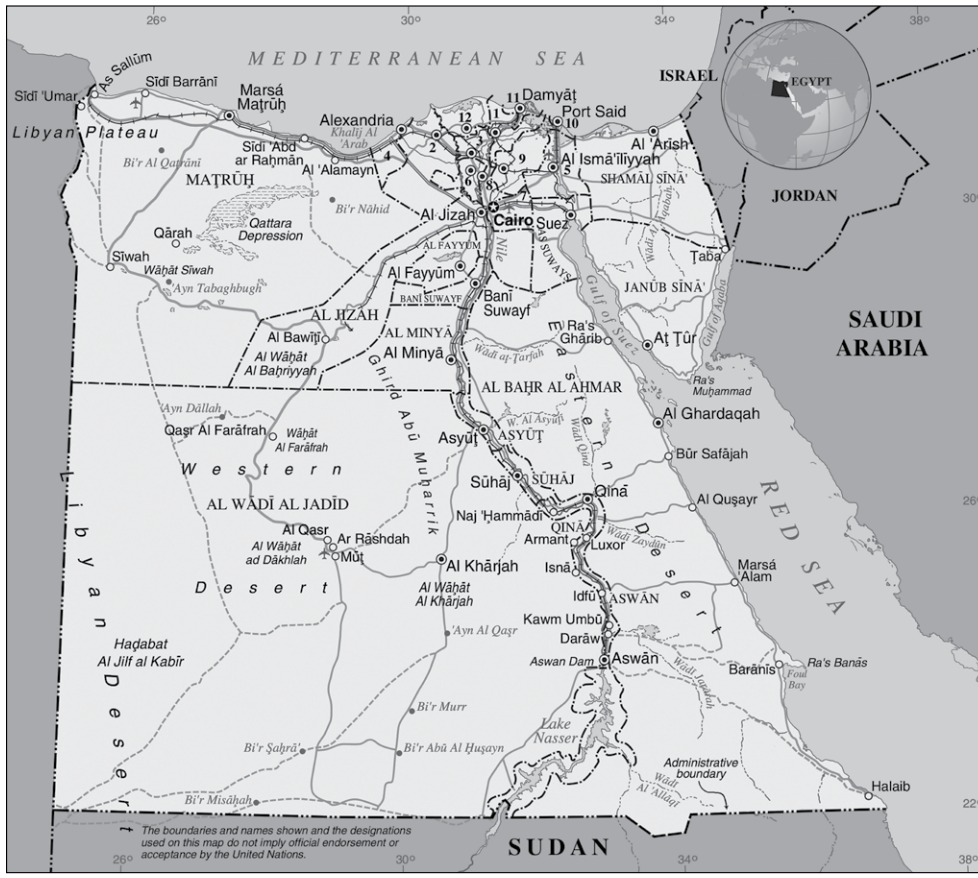
National priorities were also established. They include new and renewable energy, desalination and water resources, nanotechnology, space techniques and remote sensing, food and agriculture, biomedical sciences (liver- and kidney diseases and cancer) as well as ICT, social sciences and Humanities. Due to an efficient network of Framework Programme 7 focal points (FP7) involving key research actors, i.e. universities, research centres, industry and other institutions coordinated by the MHSER, the country was able to significantly increase the participation of its researchers in the European FPs. In addition, a national Joint Research/Industry Fund supported by the MHESR and the Ministry of Trade and Industry and a number of projects funded with the objective of promoting links between industry and the research community in Egypt was established.

In the wake of the 2010/2011 Revolution, a new strategy seems to be in the making. It will stress the need for marketing scientific research and to transfer its findings to final products in a way to support the comprehensive and sustainable development of the country. Emphasis will be in particular on efforts to harness the knowledge of the scientific diaspora and initiatives to ease the commercialisation of research results and protect technologies imported from abroad.

Source: Dubarle, P. & Woyessa, Y. 2016

It should be noted that while collaboration is now well established with European countries and the RDI programme is backed by a USD 28 million grant from the EU,[11] the level of cooperation with neighbouring countries in Africa and the Middle East has been minimal. This stems from the lack of collaborative culture and/or political will. Funding has been the greater obstacle thus far to the creation of regional partnerships in the field of research and technologies. There are nevertheless several regional organisations that could be host for these partnerships and many sources of funding in the Gulf States.

Figure 4.2: Map of Egypt



Source: World Fact Book, n.d.

11 The first phase of the programme used a grant of USD 16 million over three years to fund fifty-one research projects. Up to 40% of the beneficiaries belong to the manufacturing sector. Three-quarters of the projects are considered as successful.

2.6.4 Shortage in skills to manage intellectual property

Patent management remains thus far an important hindrance to the development of product and process innovation. TTIC, when they were created, were supposed to help local companies acquire new technologies from abroad and to protect their own innovations under the Egyptian developing IPR system. Raising awareness of IPR issues among policymakers and the industrial development community was part of the mandate of the centres. The IMC also launched an IPR help desk, providing information and guidance. So far these trends have been very slow to materialise and the patent office is not working efficiently. Intellectual property laws are fragile and do not provide newly transferred technologies with adequate protection against imitation.

In most intermediary organisations there is no clear IP ownership and revenue sharing policy in place. Most funding bodies want to take full ownership of any commercial exploitation, leaving the researchers more or less out of the loop. TTIC require owning any IP linked with the transfer of foreign technologies. For IMC and STDF the policy varies. In the innovation programme, IP is shared equally between the two institutions. RDI applicants from industry and academia bear the cost of IP protection and agree in advance about IP ownership and revenue sharing. Most TTOs do not cover the cost of international patent filing, because of their limited budget.

3. The case of South Korea

During the 2000s, the South Korean central government made use of the innovation policy-making 'toolkits' of the OECD countries and adapted a number of the initiatives analysed above. It placed science and technology at the top of the policy agenda in the middle of the decade. At the same time a technology roadmap was established to trigger a transition towards a science- and technology-based society. South Korea needed to increase its share of indigenous innovation in R&D while emphasising less on research linked with imitation and absorption of technologies from abroad.

Emphasis on R&D policy is not new in South Korea, dating back to the early 1980s when government policy shifted from industrial policy to technology policy. Those policies, combined with the growth pole strategy pursued, have contributed to rapid economic development. They have also resulted in regional imbalances and a concentration of development in the capital area. To cope with these problems, the government launched major decentralisation reforms and strong balanced regional development policies.

The combination of these two streams of policy, for innovation and balanced regional development, has led the central authorities to implement a regionalised approach to promote innovation. A key element of this strategy has been to reinforce innovation networks through the creation of fifty Regional

Innovation Centres (RIC) and fifty-seven Localised Industry Development Centres (LIDC), as of 2010, with a mission to upgrade university research facilities and promote local industry (OECD, 2012 and MKE, 2010). These R&D centres include the Centre for High Quality Research in Gyeongbuk-Daegu, the Centre for Automated Process and for Electronic Parts in Gumi, the Centre for High Sensitivity Polyesters in Gyeongsan and the Centre for Automotive parts in Daegu. These centres offer SME in the region technology advice, seminars, training courses and the use of scientific equipment for test and experiments. They are often involved in joint R&D projects.

3.1 Policy successes and persistent imbalances

The science and technology policy of the government has been implemented through five years of science and technology basic plans. The most recent initiative, called the '577 initiative', targets a number of critical technologies (50), based on existing national strengths and candidate technologies (40), in order to embark on new areas. The government also launched a variety of financial incentives to encourage private investments in R&D and spent extensively on infrastructure. Technology areas selected for long term funding in 2012 in the National S&T Commission budget included space, high energy physics, renewable energy, ICT, system on chip semiconductor machine and equipment technologies.

The policy measures together with the programmes developed earlier in the field of R&D, have been instrumental in creating a climate favourable to new products and processes. The private sector and especially the main conglomerates such as Samsung, Hyundai, POSCO and LG have also strongly supported the new innovation dynamics.

As a consequence, considerable progress has been registered in recent years, spending for R&D already exceeded 3% of the GDP in the early 2010s. Efforts have also been sustained in basic research with South Korea now ranking thirteenth among OECD countries for scientific publications. The number of researchers per million people has more than doubled over a period of ten years from 2000 to 2010 (54 000 in 2010) and a steady rise in patenting performances took place during the same period. South Korea is now ranked 5th in the world for Patent Cooperation Treaty (PCT) in patent applications by the World Intellectual Property Organisation (WIPO).

Despite increasing government involvement, several weaknesses continue to be observed in the national innovation system. First of all, the quality of public research is relatively weak. For citation indexes, the country is ranked less impressively. Productivity of R&D personnel is low in a number of universities. Only at Korean Advanced Institute of Science and Technology (KAIST), Pohang University of Science and Technology (POSTECH), Seoul University and a few others, research takes place at an international level.

Secondly, given the strong focus that universities have on teaching, there is a fundamental lack of cooperation between universities and the private sector, with few technological spin-offs. Although the central government finances a whole range of Public Research Establishments (PRE), these institutes lack the diffusion mechanisms necessary to transfer research results to industry, particularly SME.

It is notable that 80% of public R&D spending goes to PRE as compared with 41% in Germany and 24% in the USA. Furthermore, given the concentration of centres of decision in the capital region, large firm affiliates in science parks emphasise vertical rather than horizontal relations thus limiting the impact of peripheral parks on their surrounding regions.

Finally, the hierarchical nature of the HE system, with a strong concentration of top universities in the capital region both in terms of quality and geography, hinders regional economic development opportunities in peripheral regions. Regions outside of the capital tend to suffer severe brain-drain which exacerbates the mismatch between demand and supply of highly qualified people in those areas.

The experiences of OECD countries have shown that strategic regional universities are well placed for developing regional technology hubs. Technology policy needs therefore to put the focus on these universities. In the case of South Korea, this would imply not only to strengthen their research capabilities and to provide incentives to faculties to fulfil innovation missions in education and service, but also to put them in a position to build new linkages with economic sectors and territorial innovation strategies. In certain cases the possibilities to add certain functions such as incubation, business technology outreach and community development assistance could be explored.

Plans have been prepared to promote local science and technology in Korea, but so far they have not been sufficiently targeted at establishing HE/industry links. The central government, nevertheless, made some attempts to correct these imbalances. It invested around KRW 260 billion (EUR 170 million) over the 2005–2010 period in the revitalisation of regional universities outside the capital area. It also launched the NURI programme (see 3.8.5). It should nevertheless be pointed out that a good industry/science relationship is also a matter of governance. Decentralisation would raise the quality of regional universities, which then would be much better tailored to demands for both skills and research in the regions.

Enhancing the contribution of small firms and medium-sized enterprises to regional innovation and competitiveness, is also necessary. SME have proven to be major players not only in job and wealth creations, but also in generating new products and processes while adapting new technologies. SME in South Korea account for 70% of manufacturing employment, 48% of value-added and 37% of all manufacturing exports.

While more than half of SME are concentrated in the capital region, their number is nevertheless decreasing in the Seoul area. SME have also become more important in the economy due to the increase in subcontracting, particularly at the regional level. Many SME lack, nevertheless, functions spanning across boundaries, such as R&D and have difficulties finding qualified personnel.

The central government has devoted a great deal of effort toward filling these gaps. It has promoted a decentralised support system and encouraged the new market of business services. Many services are supplied by a decentralised network of local branches of central government ministries and agencies, such as the abovementioned RIC. Some functions are redundant and in the absence of one-stop shops, it is not easy and often time consuming for firms to locate the appropriate suppliers.

There are also spatial inequalities with large metropolitan regions better equipped than the rest of the country. Presently, the seven largest metropolitan cities capture an overwhelming share of R&D and patent applications, accounting for 43% of total R&D expenditures in 2009 (KISTEP, 2010). Fifty-four percent of total patent applications are also filed in large cities (KIPO, 2011) with Seoul contributing to one-third of the total (OECD, 2012).

3.2 Emphasis on clusters

In many countries, the growing attention given to clusters has led to a rethinking of policies for regional small firms, also to the approach towards providing collective services to encourage regional and local business development. In the past, industrial sites were prepared and businesses were brought in, thereby creating a concentration of firms, but not necessarily emphasising their places of complementarity or potential to work together and build production chains or other types of networks. In 2008, industrial complexes, large and small, were taking up 34% of South Korean production and 45% of exports.

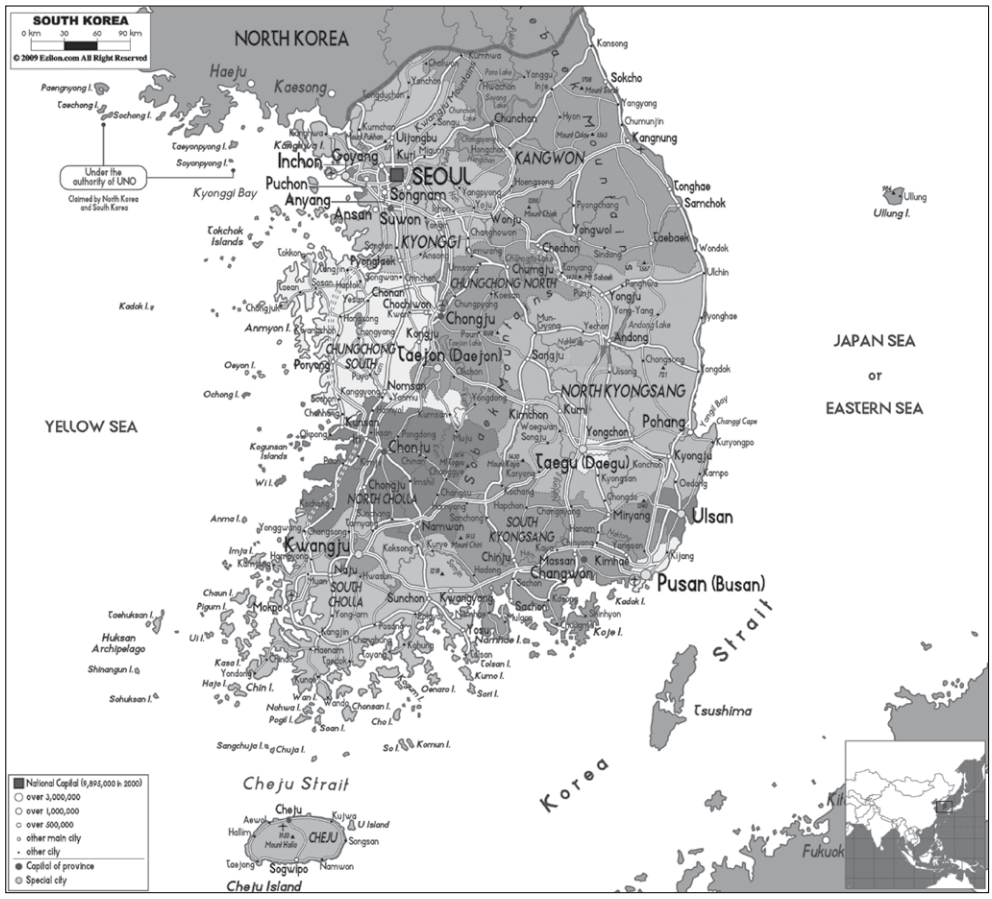
During the last decade, policy attention notably shifted to developing symbiotic clusters, i.e. dense networks where expertise and skill can accumulate and significant knowledge exchange or spillover can take place. In South Korea, this policy trend materialised some time ago. The Industrial Cluster Activation Act was passed at the end of 2002. A five year plan for industrial cluster (strategic industries) was launched in four regions in 1999/2000 and subsequently expanded to the remaining nine regions, except for the capital region.

This support was then extended during the 2003–2008 period within the framework of the National Plan for regional industrial cluster. The plan financed twenty projects in high-tech parts, material, maritime bio industry and footwear sectors in Busan (USD 575 million), twenty-five projects in the robot and bio-chemical industries in Gyeongnam (USD 550 million), forty-two projects in mechatronics,

textile and new technologies in Daegu (USD 350 million) and twenty-three projects in optoelectronics and electronics in Gwangju (USD 410 million).

Under the Lee Myung Back administration (2008–2013) the regionalisation of innovation policy was pursued, but modified. A reshaping took place and balanced regional development was de-emphasised. It was considered increasingly important for the government to take into account the globalisation of regions and cities and the emergence of mega city regions within an era of unlimited and borderless competition. Objectives assigned to regional policy included enhancing the competitiveness of regions, regional specialisation according to the characteristics of the region and interregional cooperation for collaborative development and innovation. A multi-layered approach based on a three-tiered spatial scheme of Supra Economic Region (SER), economic region and local area development was introduced (see Annex to this section).

Figure 4.3: Map of South Korea



Source: World Fact Book, n.d.

3.3 Promoting regional innovation systems

It is clear that it is not the role of public policies to try to cluster every single industry independently of its size and characteristics. Practical facilities such as industrial support centres are not enough to build a cluster either. Favourable cross-sectoral conditions for cluster development and knowledge spillovers need to be reinforced to make the shift towards innovation-based regional development successful.

Since coherent innovation policies need to be implemented, it is necessary to articulate it around a unified concept. The Regional Innovation System (RIS) is an ideal candidate. It was and still is increasingly used in many countries. In South Korea both central and local governments showed keen interest in its application and they adopted the term in their development plans.

Empirical evidence suggested, however, that while RIS was an attractive policy orientation, its viability and adequacy to local conditions needed to be assessed.[12] Turning a region into an RIS is not an objective in itself, but a framework for thinking. This can help to design innovative policies and to encourage the dynamics for growth.

The central government is fully aware of the need to have better established RIS and to strengthen them. For this purpose fourteen Regional Innovation Councils (RIC) in all the metropoles and the provinces have been established.[13] They compose of 845 industry, university and local government representatives, coming from the sixteen provinces and metropolitan cities.

Two Councils are bi-provincial: Gwangju/Jeonnam and Daegu/Gyunkbuk. These Councils have promoted innovation cafés (inno-cafés) and facilitated network hubs to intensify interactions and meetings between regional specialists and experts. In 2005 there were already 130 000 inno-café users where 66 000 consultations of information and cooperative interactions were registered. Conventions, fairs, fora and innovation festivals have also been organised to enhance innovation awareness with professionals and the public. Tacit knowledge exchanges take place within short distances i.e. within the framework of the main provincial cities. These initiatives therefore indirectly target main provincial cities and metropoles.

12 RIS are still a matter of debate in economic literature. It is often acknowledged that only a few regions can qualify as RIS, but criteria and evidence are not clear cut. Localised learning, critical mass of knowledge and intensity of interactions between firms and research institutions are often quoted as main factors for innovation, but they are difficult to assess. An interesting policy-making perspective is to analyse the conditions that facilitate the transformation of a regional economy into an RIS. The focus in this section is on the process toward becoming an RIS and on deriving policy implications from this exploratory analysis.

13 There are two integrated Regional Innovation Councils: Gwangju and Jeonnam along with Daegu and Gyungbuk.

3.4 Focussing on cities

In most cities, the separation between research poles and production function has been identified by the central government as a hindrance to the generation of local and regional innovations. This has led to the elaboration of roadmaps for seven pilot cities: Changwon, Gumi, Ulsan, Banwol Siwha, Gwangju, Wonju and Gunsan. The Korea Industrial Complex Corporation (KICOX) and the Ministry of Knowledge Economy (MKE) agency have been the driving force to convert the existing industrial complexes into clusters with strengthened industrial, academic and R&D networks underpinning the innovation cities.

The idea was to create networks between universities and industries through cooperation to exchange knowledge and to contribute to new technologies. Forty-seven mini-clusters belonging to the above pilot cities are now operational with 3 018 participants including 70% enterprises. These mini-clusters are small scale consultative bodies consisting of industry research and university experts in each complex. They were formed to strengthen mutual networking among clusters. In 2007, five new pilot complexes have been added to the list within the framework of the industrial cluster programme.

In South Korea, Innovative Cities have been designed to attract public corporations and research institutes and to develop and stimulate collaboration between innovation partners such as regional industries, universities, research institutes and local governments (see Table 4.3). In these cities, a central innovation district is organised as a space for knowledge exchange and reciprocal education (OECD, 2012).

South Korean urban policy approach has often been inspired by the Japanese model and notably by the Japanese technopolis programme and the Tsukuba concept. An interesting case in this context is Daedeok, a scientific city built in the vicinity of Daejeon that constitutes of an important share of South Korean public research institutes. Designed in 1973 Daedeok Science Town is the oldest and largest government funded science complex in South Korea.

Today the Innopolis Park consists of 410 research organisations including thirty-two government sponsored institutes and over 800 companies in advanced fields of information technologies, biotechnologies and nanofabrication, nuclear and hydropower, mechanical engineering, fuel cells, aerospace, new materials, robotics, new drugs and environmental technologies.

Table 4.3: Innovative cities in South Korea

Region	City/urban district	Population	Main concept
Gangwon-do	Wonju-si	30 000	Vitality city realising harmony of health, life and tourism
Chungcheongbuk-do	Jincheon-gun and Umsung -gun	42 000	Inno valley of education and culture
Jeollabuk-do	Jeonju-si	29 000	Bio industry hub connecting traditional culture with state of the art technology
Jeollanam-do	Naju-si	50 000	Capital of high-tech futuristic industrial cluster
Gyeongsangbuk-do	Gimcheon-si	26 000	Hub for state-of-the-art science, technology and transportation
Gyeongsangnam-do	Jinju-si	38 000	Hub for leading mechatronics Industry
Jeju	Seogwipo-si	5 000	Leading international exchange and educational training
Busan	Yeongdo-gu, Nam-gu	7 200	Hub for maritime affairs and fisheries, film and finance connecting land and sea
Daegu	Dong-gu	23 000	Hub of educational and academic industries, Centre of South East Asia industrial cluster
Ulsan	Jung-gu	20 000	Environmentally friendly high-tech energy hub

Source: OECD, 2012.

Daedeok now integrates seventy centres of public and private research and six universities, but its innovation performances have remained relatively modest. Results have been disappointing when the number of new products and patents derived from the research undertaken are considered. Therefore, new

steps have been taken by the central government to transform this science hub into a technology hub (see Box 4.6).

Ten percent of the researchers holding a PhD in engineering are now working in the area. Daedeok also uses 23% of the research equipment and 35% of the national R&D budget. A council of commercialisation has been created. Very ambitious objectives have been assigned by the MEST (Ministry of Education, Science and Technology) to the district such as the creation of 3 000 high-tech companies. An increase of USD 15 billion in business activities is expected in the years to come.

It seems that the government plans to recourse to cluster broker services to support the Daedeok Innopolis (DI) dynamic. Cross-fertilisation opportunities between firms and SME on the one hand and HEI on the other hand remain limited. It seems unrealistic to think that DI objectives could be reached in the near future.

A number of questions have been raised about Korean innovation policy programmes. It seems as though there is insufficient focus on central cities, which are the main innovation hubs and the main contributor to regional competitiveness. The policy, in fact, did not emphasise the integration between central city and their hinterland (the functional region or city/region) and is only superimposed on the provincial administrative boundaries. In addition, the policymakers did not avoid the pitfalls of a 'one-size-fits-all' approach. They failed to effectively target the mismatch between the strong industrial base in Ulsan, Busan and Daegu and their poor capacities in R&D. Busan and Daegu in particular are locked into old industrial structures and strategies. There is a need to unlearn and to depart from path dependencies in these regions.

A clear focus on competitiveness in metropoles and large cities could help to complete and deepen the policy reshaping endeavour undertaken by the new administration.[14] So far innovation policy has not really succeeded except in the capital region where the chaebols (e.g. Samsung) have numerous R&D centres. ICT clusters are also well developed in Seoul. The Regional Innovation Council Record is in particular disappointing notably, because of a top-down and relatively vague sectoral approach, poor attention to governance issues,[15] insufficient focus on projects as well as on their quality and absence of budget. The reframing of the policy could benefit from an analysis of foreign experiences.

14 Regional disparities in R&D remain huge in Korea with only 25% of national R&D executed in the non-capital regions (excluding Seoul and Daejeon). Most of the large cities outside Gyeonghi (e. g. Busan, Daegu, Gwangju and Ulsan) do not spend more than 2% of GERD each.

15 Their contribution to build visions, to assist clusters in elaborating growth strategy and to develop initiatives to foster interregional cooperation seems weak in most cases.

Box 4.6: Daedeok research complex

Daedeok Science Town is located in Daejeon City, the sixth largest city in South Korea and a transportation network hub located 170 kilometres south of Seoul. Originally, it covered 1 134 acres, of which 46% was set out for institutions for research and education, 7% for residence and community services and the rest for greenery. However, it has been enlarged up to 6 680 acres. The land is shared for the three different functions by 47%, 9% and 44% respectively. People can reach Daejeon from Seoul in about two hours by car and in about fifty minutes by KTX, the South Korean fast train.

Daedeok Innopolis (DI) was formed as the addition of Daedeok Science Town (27.8 km^2) i.e. a cluster of research entities and venture companies collaboration zones, Daedeok Techno Valley (4.3 km^2) i. e. the research and production base support of advanced business in Daedeok Innopolis and Daedeok Industrial Complex (3.1 km^2) i.e. the industrial base of DI. The Daedeok Innopolis membership includes 898 corporations, thirty-five governments invested and sponsored institutions, six universities and fifteen public organisations.

Although the private research institutes and venture businesses account for more than 90% of the total institute numbers, their manpower is lower than those of the national research institutes. Four of the private research institutes have less than thirty employees and ten research institutes have less than 100 employees, but fifteen of them have more than 100 employees. Most venture businesses are small sized (less than thirty employees).

With over 26 000 researchers and engineers and more than 10% of all South Korean patents, Daedeok has a proven track record in the commercialisation of Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Liquid Crystal Display (LCD) modules, Code Division Multiple Access (CDMA) and wireless broadband technologies. Well known for the development of the blockbuster drug Factive and for developing an AIDS diagnostic test, WIBro (Wireless broadband,) DMB (Digital Multimedia Broadcasting) and launching ten cutting-edge satellites, Daedeok continues to develop. The nano biochips of the Korea Research Institute of Bioscience and Biotechnology (KRIBB), the Korea Multipurpose Satellite (KOMPSAT) of the Korea Aerospace Research Institute (KARI) and the Korea Superconducting Tokamak Advanced Research (KSTAR) nuclear fusion reactor of the Nuclear Fusion Research Institute (NFRI) should also be mentioned.

Among the universities in Daedeok Innopolis, KAIST (Korea Advanced Institute for Science and Technology) is considered the top technical university in South Korea. Strong fields at KAIST include computer science, electrical and nuclear engineering, mechanical design, chemistry and telecommunications. Chungnam National University also plays a central role in those fields and also brings expertise in biotechnology, medicine and the agricultural sciences.

Box 4.6: Daedeok research complex (Continued)

Daedeok is also home to a large spectrum of research institutes notably KRIBB, the Korea Atomic Energy research Institute (KAERI), the Electronic and Telecommunication Research Institute (ETRI) and KARI to name a few of them.

This strong R&D infrastructure is complemented by twenty-one corporate research centres with global reach surrounded by an equal number of smaller firms. Some of the notable corporate research centres are Dongbu Advanced Research Institute for biotechnology, microorganisms and agrichemicals; GS-Caltex Value Creation Centre for environmentally friendly products including substitutes for oil; Hanwha Chemical Research for biotechnology, electronics materials, catalysts and nanotechnology; Honam Petrochemical Daedeok Research Institute for synthetic chemistry and petrochemicals, LG Chemical LTD; Research Park for Lithium Ion Battery and Polymer Battery Development; Samyang R&D Centre for Medical Research and Electronics; and SK Institute of Technology for petroleum-related research. The total residential population of DI reached 83 200 in 2009. Within this total number, nearly half (40 300) are employees in R&D units and R&D support organisations for which 16 000 housing units have been built.

Source: OECD, 2012.

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CONCLUSION

During the last decades, innovation has moved to a more prominent position on the agenda of most enterprises. Economists have been called upon to explain the economic significance of new products and new processes. Their approach has been gradually refined over the decades and the initial linear model used to describe the innovation process has been replaced by a more sophisticated vision of a multi-actor endeavour. A system is at work to generate innovation and the relationships between stakeholders are now viewed as important as the stakeholder themselves for the success of the undertaking.

Two main developments need to be stressed. First of all, it is important to adopt a subnational perspective to analyse the innovation environment. Though several factors driving the innovation process are national by nature such as patents, regulations, cultural characteristics, a majority of elements critical for innovation such as skill, industry/university linkages, SME dynamics or VC have a regional dimension. The recourse to RIC might not be surprising given the role played by proximity in the elaboration of new technologies and products. As stressed in the book, because of its systemic nature this requires exchanges of knowledge between the main partners e.g. in feedback processes. These tacit knowledge exchanges between people are often based on interpersonal relationship. It takes place locally.

Another crucial aspect, also emphasised in the book, is the role of universities and HEI. While it is clear for economists that R&D and innovation are different creatures – the former linked with science and knowledge and the latter resulting from technology push as well as from the market pull – universities are becoming more relevant for innovation. Their role has been considerably extended. They are now considered in many countries, not only as an agent of fundamental research, but also as an engine for regional and national growth. University researchers are increasingly cooperating with the private sector within joint projects or R&D contracts. HEI spin-offs are flourishing in many industrial sectors and not only in biotech and ICT.

Innovation is also playing a major role in economic policy-making. Its capacity to boost job creation and economic growth is now widely recognised. It is an important income, not only to enhance regional and national development, but also to respond to recurrent crises that have shaken the world economy. Many countries have now broadened their innovation policy scope and are using a large portfolio of policy instruments for this purpose.

Support to innovators is at the core of innovation policies, but it does not exhaust the potential of initiatives that central and subnational governments can adopt to stimulate innovation. There are also indirect ways to do so. The establishment of regulations, standards and technical specifications with amongst others more environmentally friendly products, are policy initiatives

often leading to market creation. On the demand side, instruments include public procurement. However, these instruments, when not carefully planned, can generate technology lock-ins and hamper innovation.

Innovation policies increasingly aim at maximising the regional contribution of HEI and at fostering their capacity to embark on collaborative R&D. Main targets for those policies include the development of contract research, enhancing the university services to firms and fostering their links with innovation networks. Cooperation between universities is often underdeveloped and need to be promoted for critical mass and economies of scope purpose.

It is important also not to overlook the teaching function of universities. Graduates and undergraduates are a source of innovation for the organisations they join. The capacity of tertiary education institutions to align skill development and HE and training to regional needs is critical for regions. Establishing a quality framework for internship helps in ensuring a better transfer of human capital from the universities to the business sector.

In less advanced countries and regions in general, but not necessarily only in those categories, the research culture is often not well established in academia. The infrastructure in public R&D centres is in most cases lagging behind and the provision of services for innovation remains inadequate. Governments need to devote specific efforts to the correction of these R&D gaps. Without a relatively coherent R&D base, these countries and regions will not be in a position to trigger off innovation virtuous circles and to initiate catching up trajectories.

Furthermore, in those regions, low absorptive capacities and weak innovation culture by SME often prevail. They make it very difficult for the small businesses to articulate a service demand to HEI. Support for innovation is in addition often fragmented within and among universities. Priority should be granted to incremental innovation and to match the supply and demand of services. Innovation policymakers are often inclined to mostly direct their support to highly visible, but limited and marginal high-tech segments of research. To the contrary, policies should be mainly focussed on non-high-tech and traditional industries of relevance to the regions.

The three policy case studies that were briefly analysed, confirm the validity of the above assertions. They also stress the specific problems faced by low income countries (Egypt), emerging countries (Brazil) and newly advanced nations (Korea). A few common conclusions could nevertheless be drawn from these limited samples. Firstly, innovation policy is a core component of economic policy in those countries. It aims at reactivating growth and development in Egypt, at giving more weight to endogenous development in Brazil and at consolidating the national technological leadership, particularly in a number of high-tech segments and niches in Korea.

Secondly, SME are a major target for innovation policies. The weak orientation of the SME sector towards R&D and innovation is of course a concern for policymakers in underperforming countries such as Egypt which is ranked at 124 for innovation and Brazil, ranked at sixty-two in the WEF classification. In Brazil the number of innovative SME seems difficult to increase. Korea is ranked at seventeen and one of the most advanced countries in a wide array of technologies, entrepreneurial activity (per capita). However, it remains relatively low and not in line with the progress achieved in R&D spending, with the increasing volume of the population of researchers and with the steady rise registered in patenting activities. The central government has put start-ups, firm formation and VC at the heart of its recently launched Creative Economy Action Plan (2013) to address the issue.

Thirdly, the underachievement in the Higher Education and Training sector stifles the regional capacity for innovation and reduces the efficiency of domestic policies. In Egypt, the main problems are the insufficient enrolment in tertiary education institutions and the lack of funds. In Brazil, more than 80% of researchers are employed by the public sector and mainly by universities leading to a shortage of scientists and engineers in the private sector. In Korea, the best performing universities are concentrated in the capital region making it difficult to attract talents in the rest of the country. Moreover, the strong focus on teaching in universities reduces the potential of industry/university linkages and the generation of spin-offs.

Impacts of innovation policies are often limited and should not be overestimated. Since the early 2010s, Brazil fell seventeen places in the WEF innovation ranking and Egypt twenty-one places, pointing to the negative influence of the deteriorating growth and competitiveness performances of both countries in the wake of the financial crisis.

Innovation policies are nevertheless not static and can be innovative. New concepts and methodologies have been introduced over the last decade such as smart specialisation, multilevel governance, inclusive policies or policy learning through new metrics, assessment system and experimentation. These innovation policies that originate in advanced countries gradually diffuse to other countries. They pave the way for new progress and new efficiency gains.

APPENDIX A

APPENDIX TO CHAPTER 4: THE NEW REGIONAL POLICY FRAMEWORK

1. Supra economic region

The concept of a new Supra Economic Region (SER) is a spatial strategy to secure international competitiveness of Korean regions through economies of scale in industry, R&D and infrastructure. This is based on the idea that a city in the narrow sense is a less viable unit of spatial organisation than city/regions or a regional network of cities (Scott, 1999).[1] A SER is more than a simple grouping of regions thus characterised by commonalities in economic, social, cultural and political aspects, functioning as a single economic entity. A SER satisfies at least four basic conditions: First, the population size and economies exceed a certain level, thus, they have various industrial, economic and human resources. Second, there is a significant level of urban agglomeration supported by industrial clusters and an education and cultural foundation. Third, they operate modern infrastructure necessary for international exchange such as hub airport and container port. Fourth, they possess homogeneity in natural, economic, social and cultural characteristics (Lee, 2006).

Within the framework of Korean policies, the SER concept has already been used in the 4th Comprehensive National Territorial Plan (CNTP). The Lee Myung Bak administration considered it as a means to reverse deepening interregional disparities and to promote self-supporting regional economies rivalling the Seoul capital region and overseas competitors. It was expected that efficiencies and scale economies of policy implementation would be improved by employing wider spatial perspectives compared to that which is based on segmented administrative areas.

Since Korea is surrounded on three sides by sea, SER projects emphasise marine environment, marine energy, transportation infrastructure, logistics and tourism among other themes.

A possible configuration could be implemented in the Capital Supra Region organised around the cities of Seoul and Incheon and the Provinces of Gyeoggi and Gangwon. The focus would be on upgrading its main functions and promoting the SER as a global business, financial and knowledge-based hub. Industrial clusters such as LCD (Paju), semiconductor (Suwon) and parts industries (Ansan) need to attain world competitiveness. Key international infrastructures such as Incheon airport, Incheon port, Pyeongtack port and

1 According to Scott, city/regions have become more significant as bases of production activities whether in manufacturing or services, in high technology or low technology sectors.

Yangyang airport in Gangwon would be mobilised for Yellow Sea and Pan East Sea links.

1.1 Central Supra Region

A Central Supra Region consisting of Daejeon and North- and South Chungcheon Provinces. The main directions of development would be to improve the status of the region as the new centre of the country. Daejeon would reinforce its education and business functions while Daedeok, as a R&D complex would strengthen its supporting role for industrial production. A clear focus on bioindustries would help to enhance the competitiveness of metropolitan Daejeon.

1.2 South West Supra Region

A South West Supra Region regrouping the city of Gwangju and the provinces of North- and South Jeolla. Gwangju, the central city of the region, will reinforce higher order functions such as education, distribution, finance and manufacturing industries. Gwangju High-tech Complex needs to be developed as a R&D hub of the region. The Free Economic Zone (FEZ) can be considered as an important base to attract FDI in high-technology and tourism. Development should also thrive around Muan International Airport and Gwangyang port.

1.3 South East Supra Region

This will include a South East Supra Region with three major cities: Busan, Ulsan and Daegu. These are part of this region, as well as the provinces of North- and South Gyeongsang. This region is number two in Korea and is host to the largest heavy- and chemical clusters in the country. The main direction of development is to create superclusters in parts and material industries in Busan. It also concentrates on and in machineries, automotive and shipbuilding in Changwon, Noksan national complex and in the Ulsan auto valley. An IT cluster is being formed in Daegu connecting the technopolis and neighbouring industrial complexes (Gumi and Chilgok high-tech village).

2. The scheme for economic regions

In the same vein, this scheme is designed to improve regional competitiveness via interconnection and cooperation among smaller individual regions. The sixteen provinces are grouped into seven economic regions as major policy units. Each region composes of one to three large cities and five to eight million people apart from the capital region (23 million) and Gangwon and Jeju

(1 to 3% of total population).[2] These cities and their hinterlands account for more than 50% of the Gross Regional Product (GRP) on average.

The regional strategy is contained in the Economic Regional Development Plan (ERDP) that is designed for each given region. These plans of the ERDP have a strong impact on cities belonging to the region, because they address industry, S&T, cultural, infrastructural and institutional issues that to a large extent affect urban areas. Two propulsive industries are selected by each Economic Regional Development Committee (ERDC). Regional stakeholders will find it critical to develop key technologies for these industries in hub universities or Government Research Institutes (GRI) that are rather located in metropolis and big cities. Main infrastructure projects are also mainly developed in metropolises. In addition, metropolitan mayors are members of the ERDC and will voice urban interest in the debates of the Committee.

3. Daily Living Sphere

The scheme for local areas, also known as the Daily Living Sphere (DLS) scheme corresponds to the space of residents' everyday lives to improve living standards. As such this scheme aims at providing stable jobs and basic services to cities and counties. A total of 163 cities and counties, excluding wards in Seoul and other metropoles, are eligible for the scheme. They accounted for 54% of the population in 2007.

The plan calls for both local government efforts to foster their growth potential and central government support to guarantee minimum living conditions. In particular it seeks to provide development directions for small and medium-sized provincial cities that have been overlooked in the metropolis-focussed development policies.

Although not mandatory, over 90% of the DLS are making their own development plans. Their tasks are to elaborate strategies to mobilise local industries using local endowments, to leverage cultural and historical assets and to establish a collaborative system through the networking of local communities and organisations. These plans should aim at improving public services, cultural facilities and programmes for residents, at strengthening educational competitiveness and at improving housing, job opportunities and water services.

2 The provinces and large cities integrated in each region include: a) Capital region: Seoul, Incheon, Gyeonggi; b) Chungcheong region: Daejeon, Chungnam, Chungbuk; c) Honam Region: Gwangju, Jeonnam, Jeonbuk; d) Daegyeong Region: Daegu, Gyeongbuk; e) Dongnam region: Busan, Ulsan, Gyeongnam. Gangwon and Jeju Region are identical with each province and do not contain large cities.

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This book provides an excellent analysis of regional innovation policy issues and developments with a wealth of examples, notably from OECD countries. Key policy areas, such as clusters, support services, and higher education institutions, are well documented.

The research methodology is founded on the experience accumulated by the authors over several decades in many different countries in the context of a world class international organisation. This allows a good selection of policy relevant examples and an experienced presentation of them.

Jean-Eric Aubert

Former programme manager, World Bank and OECD

This publication is a synthesis of research – primarily done by the OECD – of international experience around regional innovation policies. It provides a useful summary of the international situation in terms of regional innovation and regional policy to stimulate innovation.

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