Enhancing the Innovative Performance of Firms

This publication is part of an ongoing series highlighting some of the results of the UNECE Subprogramme on Economic Cooperation and Integration. The objective of the Subprogramme is to promote a policy, financial and regulatory environment conducive to economic growth, knowledge-based development and higher competitiveness in the UNECE region.

It covers different thematic areas related to this objective including innovation and competitiveness policies, entrepreneurship and enterprise development, financing innovative development, public-private partnerships for domestic and foreign investment, commercialization and protection of intellectual property rights.

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Policy Options and Practical Instruments

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ENHANCING THE INNOVATIVE PERFORMANCE OF FIRMS:

POLICY OPTIONS AND PRACTICAL INSTRUMENTS

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NOTE

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FOREWORD

Innovation in the modern economy emerges from a continuous interaction between firms, their suppliers and buyers and external actors like universities or research and development organizations. Firms are not isolated in their innovation activities but rather perform them in networks and these activities are highly dependent on the external environment at the sectoral, regional and national levels. The new models of innovation emphasize the collaborative relations among innovation stakeholders as a source of competitive advantage for the firms.

At the same time, commercializing an innovation is a very difficult process, especially for start-up innovating entrepreneurs who face numerous barriers in the financing, technological, managerial, regulatory, administrative and other spheres. The main role of public policy in this regard is to establish a conducive environment that supports innovating entrepreneurs in bringing their innovation to the market. This includes both direct and indirect support through various public agencies but also public support for the establishment of private innovation support institutions.

The main objective of this publication is to provide an overview of policy options and practical instruments that can help in fostering the firms' innovative performance. It draws on policy experiences and good practices in the UNECE member States aimed at supporting firms' innovation activities and develops further the results already contained in other recent publications prepared in accordance with the Programme of Work of the UNECE Committee on Economic Cooperation and Integration. It addresses issues such as the importance of framework conditions for enhancing the innovative performance of firms, the role of industry-science linkage as well as various options of boosting the efficiency of innovation support institutions.

The review of policy options and practical instruments presented here aims to contribute to improved level of policymaking and more efficient practices in promoting knowledge-based development and technology-based catching up. It is oriented not only towards policymakers dealing with innovation policy, but also towards a wide range of practitioners responsible for the promotion of innovation. I hope that this publication will contribute to the dissemination of good practices in fostering the firms' innovative performance as well as to improved knowledge and practical skills of innovation stakeholders and policymakers.

Ján Kubiš
Executive Secretary
United Nations Economic Commission for Europe

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A major substantive contribution to the publication by Malcolm Parry, Director of Surrey Research Park and Vice Chairman of the UK Science Park Association, is gratefully acknowledged.

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ABBREVIATIONS

CLOE	Clusters Linked Over Europe
FDI	Foreign Direct Investment
HEI	Higher Education Institutions
ICT	Information and Communication Technology
IKED	International Organisation for Knowledge Economy and Enterprise Development
IPR	Intellectual Property Rights
IRE	Innovating Regions in Europe
ISR	Industry-Science Relations
ITC	Innovation Technology Centres
KTP	Knowledge Transfer Partnerships
NDA	Non-Disclosure Agreement
NIS	National Innovation Systems
PPP	Purchasing Power Parity
PRO	Public Research Organizations
SME	Small/Medium-sized Enterprise
TNC	Transnational Companies

INTRODUCTION

Innovation in its many forms has been recognized as a critical dimension in improving economic performance in knowledge-driven economies. The innovation activity of firms is a key driver of competitiveness and economic growth. Although the process occurs at a company level through skilful management, a firm's innovation performance can be enhanced by appropriate policy measures conducted in a business-friendly environment. Therefore, the identification of the policy options and instruments available to enhance the innovative capabilities of firms is an important component of any strategy to support increased living standards.

This document focuses on policies facilitating innovative, knowledge-based development in the UNECE region. It is illustrated with examples of practical know-how, hands-on experiences and case studies with a view to developing practical guidelines. It has been prepared using information provided by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies and other practitioners engaged in promoting knowledge-driven development in UNECE member States. The document draws on their national experience and is intended as a reference handbook. It also tries to take into account the viewpoint of the business community as regards the most important features of social, technology and business environments in order to be most effective in encouraging innovation.

The establishment of an environment supportive to the innovation activity of firms calls for the coordination of a number of policies and the related public investment that will help in shaping the "soft" and physical infrastructure as well as the legislative framework in which the private sector operates. The national innovation system provides an institutional and business environment that supports the creation and demand for knowledge as well as its diffusion and absorption into business activities.

In the end, the most effective influence on business is market opportunity. Businesses will innovate when they see innovation as an important business opportunity. This implies that companies can both recognize and understand how to exploit the innovation-driven market. Policy can also provide support to businesses in identifying innovative business opportunities. Innovation by companies also requires access to capital to commercialize innovative market opportunities. Capital needs to be channelled to innovating companies in an effective manner to make the innovation process self-sustained.

Among the key factors driving the innovative activities of firms are the following:

- Investment in education that is relevant to business. Universities need to link with business and develop courses that are relevant to the operational units that make up national innovation systems.

- Support to investment in R&D by both government and business. Governments can stimulate private R&D investment by ensuring that the fiscal structures provide the necessary incentives to businesses.

- Business investment in innovation strategies. This can be stimulated by both relevant education and incentives to influence companies so that they recognize the need to change. Appropriate management training programmes can support this process.

- Specific policy measures to address the concerns of SMEs and to provide a conducive environment for such firms to engage in the commercialization of innovative business opportunities.

- Establishing strong and self-sustained industry science linkages. Public policy is a key factor for stimulating the cooperative efforts of all relevant stakeholders in the innovation process.

- Policy needs to drive the development and support of the soft and hard infrastructure that breeds innovative companies. Careful consideration should be given to planning and developing innovation support institutions and the related business support programmes.

- Joint efforts by public and private sector (public-private partnerships) are an efficient and effective way to develop innovation support institutions.

Governments in cooperation with other relevant stakeholders also need to improve the management structures to identify and protect intellectual property with commercial value in order to broaden the scope of the entrepreneurial approaches to appropriating the benefits of intellectual property and of the investment in innovation.

This document contains an overview of good practices and lessons learned in these and other areas supporting the innovative performance of firms based on the experiences of UNECE countries.

I. POLICY OPTIONS AND INSTRUMENTS TO SUPPORT FIRMS' INNOVATION PERFORMANCE: AN OVERVIEW

Executive Summary

- *In today's economy it is necessary for all companies to connect knowledge to the market successfully in order to remain competitive.*

- *Governments can facilitate and support firms' innovative activity by adopting new and better ways to create supportive environments in highly competitive markets.*

- *The approach adopted by companies can range from incremental innovation which is focused on a continuous improvement of their offering to market, to more radical innovations which represent a step change compared with other products and services on offer.*

- *Radical innovation carries with it some risks for large companies as step changes may cause a disruption to their existing market. In contrast, radical innovation carries fewer risks for SMEs that are trying to enter an existing market through exploiting step changes because all they are trying to do is gain some traction and market share for the future.*

- *With the increasing pace of change, many larger companies are looking to increase their rate of innovation by developing innovation strategies which include internal restructuring, creating innovation teams to which the company delegates the innovation role, funding these with a central innovation fund, allying R&D effort to innovation teams, adopting open innovation programmes and securing innovation by mergers and acquisitions.*

- *The intention of open innovation is to draw in ideas that have commercial potential from a wider catchments than just within their own company.*

- *This change in internal systems to increase the chance of innovation reflects a better understanding of the process being neither entirely based on technology push or market pull of ideas but an iterative process which engages people with skills in technology, marketing and business economics in driving innovation up the value chain.*

- *A number of models for pursuing innovation have been developed and adopted over time. Some have focused on increasing investment in R&D to drive innovation by technology, others have focused on challenging those developing technologies to deliver market solutions. Current good practice combines investment in both the*

knowledge generation and knowledge utilisation sides of the equation and through an iterative process delivers innovations.

- *The importance of innovation has prompted many countries and regions to put in place national/regional innovation systems to support the generation and diffusion of innovation and to raise its role in economic development.*

- *Choices exist where public resources are channelled to various components of an innovation system. Options include, on the one hand, strengthening knowledge creation and, on the other hand, increasing demand for innovation, or a combination of the two. In addition, resources can be allocated to strengthen the links between the components by putting soft infrastructure in place to support the activities in the innovation system.*

A. Why firms' innovation activities may need external support

A definition of innovation

Innovation can be understood as the successful commercial or social exploitation of new ideas where the idea is successfully brought to market (or in a social context reduces social costs or improves social services), by offering a more effective alternative to existing arrangements.

Why is this issue of such importance?

Innovation is a basic source of competitiveness in modern knowledge-based economies. It results in increasing living standards and contributes to the solution of environmental and social challenges. Box K1.1. elaborates on this issue and its implications.

Box K1.1. Why is innovation important?

According to the views expressed by the British Government [1], innovation is the successful exploitation of new ideas. These ideas improve the way we do things and the things we make: the things that allow a business to remain competitive. Some ideas are small and iterative; others can create an entire paradigm shift. Evidence shows that businesses that have the awareness to continually create, evaluate and successfully exploit their new ideas are more likely to survive and prosper in the competitive global economy.

Innovative businesses benefit the economy: delivering added value; high quality jobs; successful business; better products and services for customers; and new, more environmentally friendly, processes.

In order to deliver the Government's overall ambition for wealth creation and productivity growth, sustained business investment in innovation will be necessary. For its part, the Government is investing in the UK science base and interventions that support and encourage innovative companies to invest in R&D and collaborate with each other and with academia to turn ideas into profit.

This view comments on four key issues:

- The need for innovation in order to build and retain a competitive economy;
- Government must invest in the country's science base;
- There must be operational links between the supply of science and technology and the organizations that utilise these research outputs for commercial purposes; and
- There must be sustained investment by business in systems that deliver innovation.

Governments have control over the supply side of this process but can only try to influence the demand side.

What does innovation mean to different companies?

Experience shows that innovation can range from slow incremental changes to an existing idea to a radical shift in a technology that makes a step change in a process.

[1] *Source*: UK Department of Business Enterprise and Regulatory Reform, available at www.berr.gov.uk/dius/innovation/index.html.

Box K1.2. Incremental and radical innovation

An example of incremental innovation has been the slow change in camera technology over the last century, from the plate camera to the Single Lens Reflex camera. Even today digital cameras still rely on the simple principle of allowing a light sensitive material to be exposed to controlled amounts of light that are in principle controlled in the way and the period they are focussed on this material.

In contrast, radical innovation in relation to photography has been replacing the light sensitive chemical medium (traditional film), with an electronic medium that captures an image: that is the shift from traditional film to digital photography.

This radical innovation has also allowed cameras to be set into a larger array of settings such as mobile phones and they are now commonly used for a range of commercial purposes because of the lower cost of the radical technology (digital photography, which emerged as a radical shift to a new idea), that has displaced a traditional film based process.

The difficulty for large corporations in adopting radical innovation is that most make substantial profits from existing stable products in stable markets, which they do not want to disturb. The problem with this approach is that continual incremental innovation can lead to products emerging from this process which are so sophisticated and have so many extra features that they provide no benefit to the customer and as a result do not capture increased market share.

In some cases the traditional markets for these “sophisticated” products are challenged cheaper and more efficient products that emerge from radical innovation. In this way the large companies begin to lose market share to the smaller companies that are prepared to take greater risks by committing resources to radical innovation.

Large corporations tend to be risk averse and are run by excellent managers that are able to analyse their markets and understand how these operate and see radical innovations as change that is beyond their logic; however, the irony of this is many of the innovations that have emerged and de-stabilised markets have come from large corporations.

What drives innovation at a product or service level?

Innovation is a process and it is important to structure businesses in the most effective ways so as to increase their innovation performance. Models that have been tried include those where innovation is driven by technology, which attempts to find a market, as well as those where technology solutions have been encouraged by the market. Consecutively, new models have emerged that combine both these sets of principles in an iterative process that brings together an understanding of technology, a clear view of a market, and an appreciation of business economics behind each step in the process (Figure 1.1.).

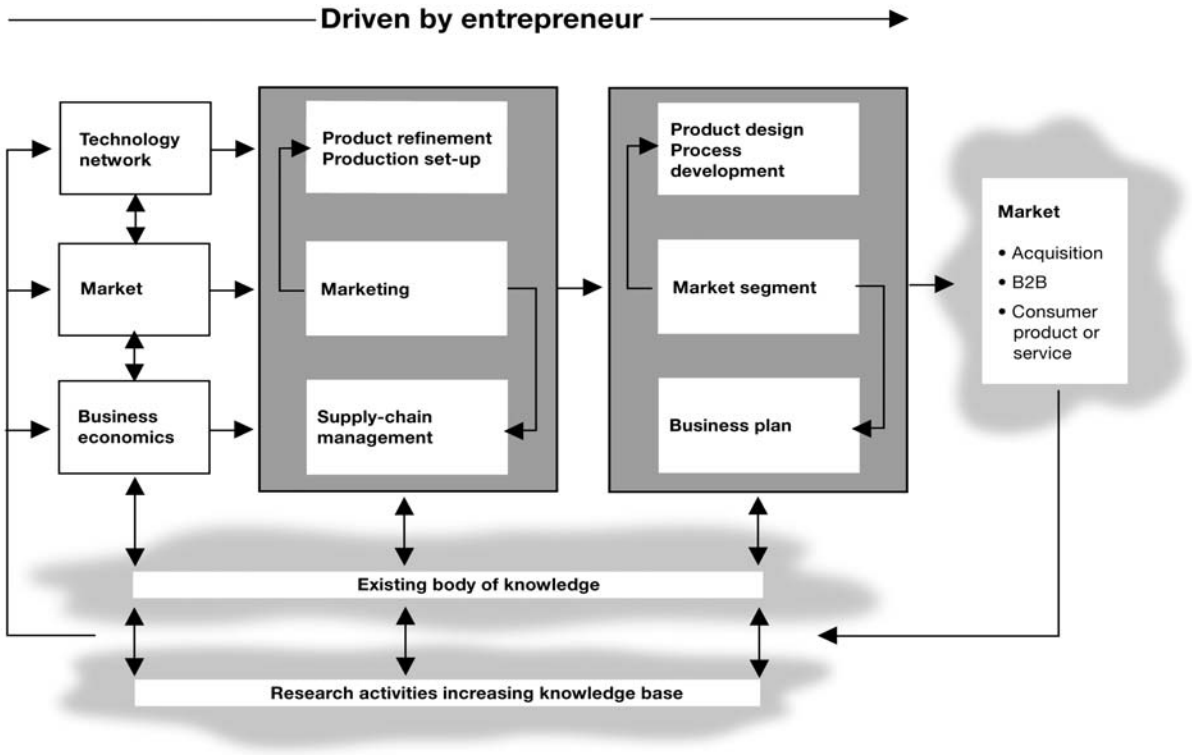


Figure 1.1. Driving forces of innovation

Source: Parry, Malcolm (1996), "The Role of Science Parks in the Process of Innovation" in Corsi, Carlo (ed), *Science and Innovation as Strategic Tools for Industrial and Economic Growth*, Kluwer Academic Publishers, Netherlands.

Innovation is a systemic process

- In the past, the process of generation of commercial innovation was considered to be confined within the firms' boundaries.

- This has changed in the modern knowledge-based economy: The innovation of a firm nowadays emerges from its interaction and technological cooperation with other firms, universities or research and development (R&D) organizations.

- Commercializing an innovation often requires interaction among numerous stakeholders, including financiers, suppliers, buyers, regulators, etc.

- Therefore, firms are not isolated in their innovation activities but rather perform them in collaborative networks and innovation activities are highly dependent on this external environment.

Innovation activity results from purposeful entrepreneurial and managerial decisions

- Companies willing to engage in innovation activities need to put in place the right management structures and systems, including making innovation the responsibility of either a member of the board or a small group, in order to combine technical, marketing and business skills.

- Public institutions mandated to support a firm's innovation activities need to put in place innovation governance structures (including science and industry councils, foresight programmes, etc.) to ensure the right decisions are being made in relation to investment in science and technology.[2]

The role of public policy

- Commercializing an innovation can be an extremely difficult and cumbersome process, especially for start-up innovating entrepreneurs.

- Start-up innovating entrepreneurs need to overcome a myriad of barriers in the spheres of financing, technological, managerial, regulatory, administrative and others.

- Innovating entrepreneurs also often find it difficult to reap the benefit of their innovation due to poor protection of their intellectual property rights.

- The main role of public policy in this regard is to establish a conducive environment that supports innovating entrepreneurs in bringing their innovation to the market.

- This includes both direct support through various public agencies and also public support for the establishment of private innovation support institutions.

B. Spurring the innovation process at the firm level: key issues and actions

Getting started: issues to be addressed by the innovating entrepreneur:

- The definition of the value proposition to customers that sits within a specific market segment;

- Developing and deploying resources to successfully address this market;

- Putting the idea into a commercial context which takes account of the cost structure of the product and the commercial margins that this will provide;

- Establishing where the new product sits in a market; and

[2] For more details see UNECE (2007), *Creating a Conducive Environment for Higher Competitiveness and Effective National Innovation Systems. Lessons Learnt from the Experiences of UNECE Countries*, New York and Geneva.

- Defining if this is what customers are looking for and what commercial benefit it delivers.

Is the commercial environment suitable? Questions to be answered include:

- What is the problem this technology solves?
- What is the compelling need for a solution?
- Who, if anyone, has a real need for the product I propose to sell, and how many potential customers are there?
- Does technology solve the problem best – and why?
- Who are the customers and can they be accessed?
- How much, if anything, are they spending to address that need today?
- What is the value proposition to the customer?
- Does my product meet that need in a way that either saves or makes them substantial amounts of money?
- How many people will buy it?
- What is the price and can this make money?
- Is there a deal killer in the project?
- What is the unfair advantage this technology provides?
- Does the business idea offer a long-term advantage that will stand the test of time and other changes in the market?
- Is the market deliverable?

Key external factors that affect the innovation process in a company:

- The market/customers;
- Supply chains;
- The skills base they can access;
- The technology base they can access and how well this is managed in relation to accessibility;
- Business support services;
- Availability of capital to support innovation;
- Fiscal structures that support innovation;
- Business related regulations;
- Social status of business; and
- The quality of communications.

Size matters for the innovation style

Companies range in size from those that are just at the point of formation with no funds to those that dominate world markets. The vast differences in the financial status of these companies means they are likely to behave in different ways in relation to their innovation-related activities. Some large corporations that have a significant R&D effort recognize the importance of innovation. However, they also understand that:

- Radical innovation can disrupt their existing markets and be commercially damaging. New ideas with commercial potential are not exploited because managers fear the effect these inventions may have on their markets.

- Their internal structures and resources many not provide all the necessary skills to innovate.

How different companies respond to the challenge of innovation?

The differences in innovation style related to size/development stage are characterized in Table 1.1.

Table 1.1. Innovation style at different stages of the firm

Turnover	Funding regime	Innovation style
Early stage €0 to €500,000	Equity funding – proof of concept / early stage fund	Likely to pursue radical innovation. Possibly drawing on externally mobilised expertise (e.g. university staff) or knowledge gained by employees while at university.
Early development €500,000 to €20m	Equity funding – angel or venture capital	Likely to pursue radical innovation. Possibly drawing on externally mobilised expertise (e.g. university staff) or knowledge gained by employees while at university.
€20m to €100m	Self funding from revenue or floatation	Radical and incremental but at upper end of the turnover range. May suppress radical change if it damages an existing market.
> €100m	Self funding from mature markets	Radical, incremental and open innovation, but may suppress radical change if it damages an existing market. May seek innovation from other sources such as universities, consultants or small radical innovation based companies.

Early stage companies:

- Typically try to commercialize is a radical innovation;
- Rely on external equity funding;
- Explore new technologies, and must develop the market for them;
- Their growth rate is unpredictable and difficult to analyze; and
- May need to experiment with different business before a successful structure is developed.

Mature companies:

- Need to innovate to stay competitive but may revert to different innovation models;
- Radical innovation can disrupt their existing markets and be commercially damaging;
- Their internal structures and existing skill sets may not provide the full breadth of innovation skills that are essential to compete in increasingly competitive markets;
- An increasing number of companies are developing a policy of open innovation, looking beyond their own internal resources; and
- Typically rely on self funding.

Closed and open innovation

The contrast between open innovation and closed innovation is illustrated in Table 1.2.

Table 1.2. Closed innovation versus open innovation principles

Closed innovation principles	Open innovation principles
The smart people in our field work for us.	Not all the smart people work for us. We need to work with smart people inside and outside our company.
To profit from research and development (R&D), we must discover it, develop it and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to market first will win.	Building a better business model is better than getting to market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our innovation process, so that our competitors don't profit from our ideas.	We should profit from others' use of our innovation process, and we should buy others' intellectual property (IP) whenever it advances our own business model.

Source: Chesbrough, Henry (2003), O*pen Innovation: The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press.

Why collaboration is important?

The new models of innovation emphasize collaborative relations between firms as a source of competitive advantage (Table 1.3.). This requires from firms the ability to develop specific skills and put in place strategies that explicitly incorporate this interaction to achieve superior innovation performance. "Collaborative innovation" should not be confused with the one-way relation of outsourcing (buyer-supplier) and its associated narrow emphasis on costs.

Table 1.3. The benefits of collaboration

Lower Costs	Superior Capabilities	Contextual Knowledge
Low cost labour	Rapid access to capacity	Market access
Low cost materials	Technical know-how	Supplier relationships
Low cost suppliers	Process expertise	Institutional ties
Low cost infrastructure	Domain knowledge	Government connections

Source: MacCormack, Alan (2007), *Innovation through global collaboration: a new source of competitive advantage*, Harvard Business School Working Paper 07-079.

Collaborative capabilities

The development of collaborative capabilities must be anchored in four pillars:

- People: Specific management skills are required to coordinate the work of distributed teams and exert influence over resources that are not under the firm's control.
- Process: Procedures need to be in place to manage collaboration. These can be refined from the experience gained from pilot projects.
- Platform: The development of technology platforms, involving tools for interaction, standards, rules sharing intellectual property and knowledge management systems facilitates interaction and creates a basis for future collaborative projects.
- Programme: As opposed to strict project-based management, a programme focus allows companies to gain better insights to increase performance.

Small and medium-sized enterprises: do they have a role?

Small and medium-sized enterprises (SMEs) are an essential ingredient in taking forward innovation that comes out of the knowledge base in a region:

- SMEs enjoy greater flexibility and can therefore take more risks than larger companies in experimenting with new processes or technologies.
- SMEs can capture ideas from the research base of universities, other public sector institutions and commercial laboratories and drive them to the market place.

A number of countries have established various support measures and instruments supporting the development of the SME sector. These measures are especially relevant for the UNECE catching-up economies, where the SME sector is an important factor for economic transformation and structural change (see Box C1.1.).

Box C1.1. Policy support to SME development[3]

Russian Federation

The Federal Law No.209-FZ formulates basic goals of government policy in fostering favourable conditions and rendering assistance to small and medium businesses in the promotion of goods, services and the results of intellectual activities in local and foreign markets. The Law provides a general framework of SME support, which is transformed in concrete measures in other normative legal acts:

- Special tax regimes, simplified tax record-keeping rules, simplified tax return forms for specific taxes and fees for small enterprises;
- A simplified bookkeeping system for small enterprises pursuing certain types of activity;
- A simplified procedure of preparing statistical reports;
- A privileged procedure for settling accounts for the state and municipal properties that have been privatised by small and medium businesses;
- The details of SME participation in state and municipal tenders for delivery of goods and services for public needs;
- Measures for safeguarding the SME rights and interests;
- Tools of financial support to small and medium businesses; and
- Development of supporting infrastructure such as business development centres and agencies, state and municipal funds for SME support, guarantee funds, science and technology parks, business incubators, marketing and business training centres, etc.

Republic of Moldova

The Strategy for Support to SME Development is the main instrument of state policy in support of SME development in Moldova. The Strategy serves as a basis for the development and implementation of programmes and action plans of ministries, other central and local public authorities, as well as the technical assistance projects of foreign donors, aimed at creating the necessary conditions for development of small and medium-sized businesses. Its main objective is to create favourable conditions for SME development and, in particular:

- To increase the contribution of the sector to economic growth;
- To increase the contribution of the SME Sector to poverty reduction through development of new employment opportunities in order to secure the population with real wages; and
- To support the creation and development of a greater number of sustainable and competitive SMEs.

Various measures in the Strategy envisage improved access to finance by SMEs; support to the development of business support services; and promotion of the dialogue between the Government and private sector.

[3] *Source*: documents submitted by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies.

C. The broader picture: The innovation system

Innovation is the outcome of longstanding collaboration and interactions between firms and other organizations. These include, for example, the connections of their staff with customers, other producers, subcontractors, consultants, public bodies such as development agencies, professional service providers, universities, and research institutions. This complex set of innovation stakeholders and their interrelations define an innovation system (Figure 1.2.).

Foundations of the innovation systems include:

- The organizations that are part of the network of a public and private actor whose activities and interactions initiate, import, modify and diffuse new technologies;
- The linkages that exist between organizations;
- How ideas flow across these linkages; and
- The ability for organizations to learn to change and use these ideas.

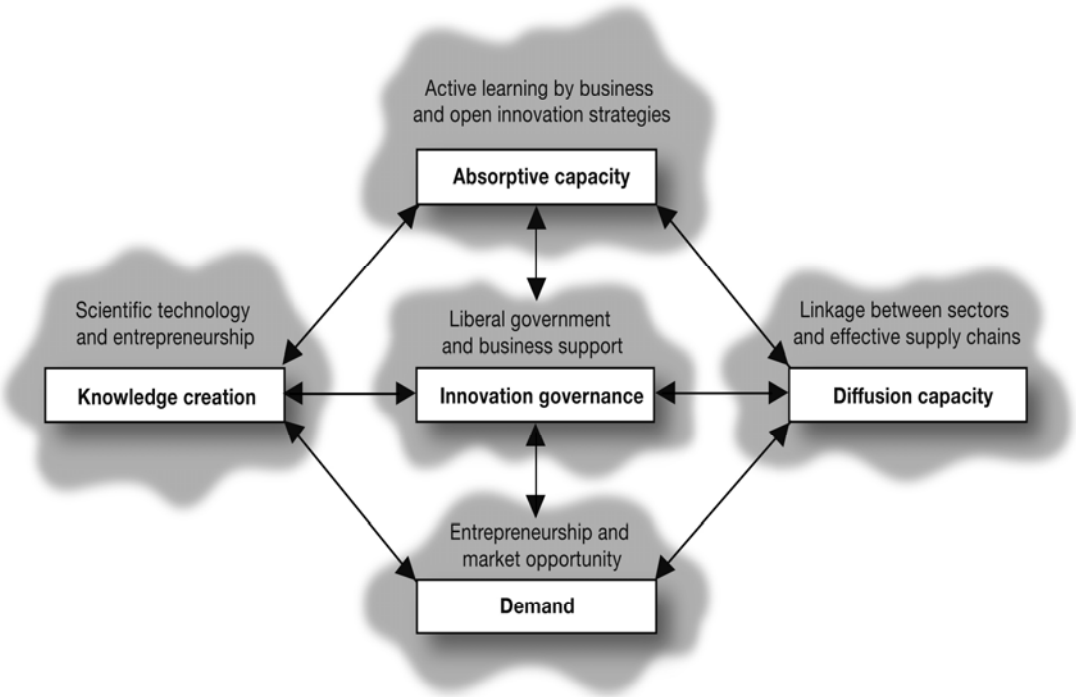


Figure 1.2. Structure of the national innovation system

Source: UNECE (2007), *Creating a Conducive Environment for Higher Competitiveness and Effective National Innovation Systems. Lessons Learnt from the Experiences of UNECE Countries*, New York and Geneva.

Innovation systems can be distinguished according to their scope:

- National
- Regional
- Sectoral.

National innovation systems (NIS) may display different features regarding the degree of centralization in the allocation of resources and the importance of local arrangements in shaping coordination agreements between business, higher education and government. A broad interpretation of the effectiveness of any of these systems can be assessed by the degree to which:

- Relevant information related to innovation and economic conditions flows through partners in the system; and
- The effective use of this information to innovate.

Regional innovation systems are more likely to produce local connections based on geographical proximity. If functional regions are too small to support key knowledge generation stakeholders, such as universities, links would have to be developed beyond the region.

What can be done to strengthen an innovation system and address any weaknesses?

An innovation system is based on the connections between organizations that produce knowledge, those that utilize this knowledge, which in this context is for its commercialization, the way this is diffused through a community of businesses, the ability of companies and others to absorb the information and finally the structure or governance of the innovation process.

In order to increase the effectiveness of any system in delivering innovation, it is necessary to undertake audits of:

- Sectoral interests;
- Existing connections;
- Routines for creating connections; and
- Emerging opportunities to support connections with public bodies, universities, public research institutions as examples, in particular, public-private partnerships (Box K1.3.).

Box K1.3. Public-private partnerships for innovation

Innovation is a risky and complex business. Public-private partnerships can be used to share these risks and develop the networks that underpin the innovation process. These partnerships allow the pooling of resources and combining of skills. Investment in basic science, which requires resources that are beyond the reach of the private sector, benefits from government funding. Commercialization of technologies requires appropriate skills, which are more likely to be found in the private sector. An appropriate legislative framework needs to be in place to allow the technology to be licensed to the private sector and suitable management frameworks should be in place to capture and package the technology that is to be commercialized.

The range of possible actions to strengthen the various components and dimensions of the innovation system is illustrated in Table 1.4.

Table 1.4. Options for improving the functioning of an innovation system

Activity	Observations on factors that increase or limit innovation capacity
Knowledge creation	• Sufficient qualified people in the economy • Relevant R&D expenditure/investment by government
Diffusion capacity	• Create science and technology park with full and pre-incubation • Linking services o Innovation Clubs o Innovation Advisory Services o Knowledge Transfer Networks o Knowledge Transfer Partnerships o Staff Exchange Programmes
Absorption capacity of companies	• Quality of leadership and staff in a company • Culture of company as a learning institution • Resources available to pursue new ideas
Demand for innovation	• Extent and demand by customer base of companies • Opportunities created by de-regulation • Quality of relationship created with customers • Regulation on the use of SMEs for some contracts • Quality, cost and regulation of IP related matters.
Innovation governance	• Fiscal system support for R&D and innovation. Availability of funds to fill early funding gap • Legislation and structures that influence management of research base and IP Legislation on mobility industry-academia

The need for systemic coordination

Effective implementation of innovation policy requires the presence of an efficient institutional system. The horizontal nature of innovation policy and the variety of entities involved in innovation performance at both central and regional levels demands appropriate coordinating mechanisms (Box K 1.4.). This is particularly the case in the area of science and technology. In a number of countries the role of systemic coordination in the implementation of innovation policy – as well as the general supervision of the NIS – is delegated to special public bodies, known as Innovation Agencies (see Box K 1.5.).

Box K1.4. The public sector role as coordinator

Innovation is a complex process, which results from the interaction of many agents, public and private, over an extended period. It is critical that the public sector provides the leadership and vision to coordinate these efforts and to promote a culture of enthusiasm for innovation. In particular, public initiatives can create innovation platforms that bring together policy, business, government procurement and research perspectives and resources to generate innovative solutions to existing challenges.

Three levels of coordination can be distinguished:

- Planning of policy and shaping of strategy by the government and particular ministries. Advisory bodies are also involved to some extent in these efforts.
- Entities that provide financial support to research activities (scientific boards and agencies dealing with innovation).
- Entities that conduct research work introduce innovations and are direct beneficiaries of public funds for R&D.
- Innovation Councils (Box K 1.5.) can also have a role in the coordination process.

Box K1.5. Innovation Agencies and Innovation Councils

The creation of an Agency responsible for the process of implementation of innovation policies can serve to improve efficiency and deliver better outcomes. The competencies for this task can be attributed to a new organization or to an existing one, identified as a result of a feasibility analysis. In general, agencies can play a dual role:

- Coordination and provision of information, consultative and training services; and
- Implementation of specific programmes.

The coordination role should be defined in broad terms, so to encompass the different aspects of the multifaceted innovation activity. A particular emphasis should be made on the activities of the implementing Agency as an actor of the national innovation system, emphasizing not its direct participation in the allocation of public resources but its role as a dynamic partner and source of initiatives in spurring the innovation activity of firms and R&D institutions.

The idea of Innovation Councils, established at the highest level of the hierarchy to manage innovation policy, is gaining more and more support in Europe. The main objectives of such councils include preparing strategic development directions and evaluations of government policies in the area of innovation. Simultaneously, councils are mandated to build a consensus as regards the initiatives supporting innovation among different stakeholders (government, entrepreneurs, scientific circles and non-government organizations) operating for the benefit of innovation growth. Innovation councils raise the profile of innovation policies and facilitate coordination. An example is the Polish Innovation Council, which is tasked with high-level coordination functions and the supervision of the implementation of *The Strategy for Increasing the Innovativeness of the Economy for the years 2007-2013*. In order to facilitate their functioning, Innovation Councils need to decide:

- What are their competencies and responsibilities? And how the outcomes of their actions will be measured?
- How are decisions taken?
- What are the rules that govern their operations?

II. CREATING SUPPORTIVE FRAMEWORK CONDITIONS FOR ENHANCING THE INNOVATIVE CAPACITY OF FIRMS

Executive Summary

- *Public policy has a role in establishing a business, social and technology environment as supportive as possible for businesses to innovate and to raise awareness in the corporate sector of what other parts of the system offer by way of support to stimulate the market for innovative goods.*

- *The influence of the business environment is particularly important in encouraging innovation. This includes a transparent, accessible and simply organized business infrastructure that facilitates business formation and operation and allows those in universities to create companies for the exploitation of innovation. The business environment must be conducive to investment in R&D and should not overburden business with regulations.*

- *Pursuing policies to develop a culture of innovation and to increase the demand for innovation requires well functioning markets for technology products. Public support to market development represents an important strategy in trying to build capacity in a region.*

- *Innovation activity has a regional aspect as an important part of the innovation capacity is provided by a region's skills base, including adequate supply of the right skills and the cost of these skills. Addressing these issues requires cooperation between local authorities and employers. This process helps to identify skills gaps in the regions, which can be filled through the provision of relevant training or by targeted investments related to these needs.*

- *One of several strategies for building a skills base is to provide external direct advice, mentoring and coaching to companies. The creation of an innovation advisory service encouraging companies to develop the necessary internal structures supporting innovation can be instrumental in promoting an innovation network across the region.*

- *A related policy is the support to the selective development of courses in universities aimed at meeting specific local needs.*

- *Policy interventions aimed at strengthening the operational units and linkages that make up the NIS also support firms' innovation activities. Examples include public investment in knowledge creation and its management, measures seeking to increase demand for innovation, public support for the links between the operational units in the innovation process as well as establishing specific incentives for companies to cooperate in their innovative efforts.*

- *Some countries have applied policies aimed at improving their technological environment by attracting foreign direct investment (FDI). Strategies to do this include importing technology, attracting investment to "greenfield" sites or establishing new companies through merger or acquisition to build the innovation capacity in a region. Driving this process requires capacity-building in terms of skills, adequate physical infrastructure and access to markets.*

- *There may be a need for specific policy measures to support the innovation activities of small and medium firms (SMEs). This is necessary as the resources available to SMEs are limited, especially while they are in the early stages of development and vulnerable to cash flow problems. One specific option to support SMEs is to facilitate their integration into supply chains and increase networking across regions*

- *There are ways of structuring government R&D spending in order to address industrial relations that drive innovation. Examples include funding of knowledge transfer partnerships and, on a more generic basis, knowledge transfer networks. These knowledge transfer networks link broad groups of organizations that have a common interest in a particular technology.*

- *In addition to supporting investment in R&D through grants for early stage ideas and matched funding programmes for technologies, there needs to be effective fiscal structures encouraging firm investment in innovation.*

- *Establishing supportive framework conditions for enhancing the innovative capacity of firms therefore requires placing immediate policy based actions into a longer-term strategic policy framework.*

- *Short-term policies that support business development may include funding support to technology which has commercial potential, creating support services for business, running business awareness courses on how to create an innovative environment in a company, stimulating innovation in business through relevant procurement programmes and focusing on skills that would enhance the market potential of existing industrial activities.*

- *Strategic policies need to build long-term innovative capacity by more widely promoting the processes that drive innovation, building relevant skills and investing in R&D that has long-term commercial potential.*

A. The importance of framework conditions

National policies create frameworks that define priorities for investment. Some of the social challenges faced by society today also represent business opportunities. Strategic investment in technologies that try to resolve these challenges, if they are successful, will not only benefit the country but also create a global market for these technologies. Investing in a range of leading edge technologies is a prerequisite for maintaining international competitiveness and the capacity to innovate.

The innovative performance of firms therefore depends on the economic, social and policy context in which these companies operate. These framework conditions for innovation shape the overall environment for innovative activity and determine the constraints and opportunities faced by companies.

Typology of framework conditions:

Framework conditions for innovation can be classified into four main groups:[4]

- Public knowledge creation:
    - Public investment in knowledge
    - Relevance of research
    - Quality of research
- Cooperation on innovation between knowledge institutions and the private sector:
    - Cooperation in R&D
    - Commercialization of research
    - Presence of highly-educated workers
- Innovation financing:
    - Subsidies and tax incentives for R&D
    - Access to venture capital
- Market conditions:
    - Access to technology
    - Competition policy
    - Competencies of users and suppliers

How governments can shape framework conditions?

Governments can intervene to improve these framework conditions. In particular, they can:

- Invest in a country's science base and design interventions that encourage innovative companies to invest in R&D and collaborate with each other and with academia to turn ideas into profit.
- Support the creation of a large pool of talented R&D personnel that is well resourced.
- Provide a supportive and coherent environment that allows innovation to thrive. This includes:

[4] OECD, Benchmarking Innovation Policy and Innovation Framework Conditions, Paris, 2004.

  - Strengthening the innovation capability of SMEs by facilitating access to relevant technologies.
  - Fostering the development of networks.
  - Addressing the difficulties that innovative enterprises face in raising finance.

- Encourage society to understand, embrace, and value innovation and technology.

- Ensure that the national physical infrastructure supports business.

- Create markets for technology, removing distortions and generally increasing the scope for competition.

Competition, regulation and innovation

One of the drivers for innovation is the opportunity afforded by a valuable market. The Internet, despite the early setback of the "dot com bubble", provides numerous examples of the materialisation of these opportunities, including Google and many of the numerous on-line retailing businesses.

New opportunities are stimulated by:

- The emergence of new platform technologies; and
- The liberalization of markets. For example, earlier rounds of innovation in the UK occurred when the telecoms industry was deregulated in the early 1980s.

The confluence of these two forces results in:

- New products
- New business models.

The entry of new companies in a particular sector can encourage competition and drive innovation (Box K2.1.). However, the relationship between competition and innovation is ambiguous:

- A competitive market is an incentive for companies operating in that sector to innovate, so to obtain an advantage from competitors. However, if innovation can be easily replicated, the expected benefit decreases, so the rationale for innovating declines. Temporary protection may then be justified, as is the case with the award of patents.

- Some degree of market power reduces uncertainty for would-be innovators and facilitates funding.

Absence of formal barriers, as brought about by deregulation is not sufficient. In addition, new entrants require:

- A conducive environment, in particular regarding financing and business support to overcome initial barriers to entry.

- Removing other bureaucratic barriers that stifle business growth.

Box K2.1. Entrepreneurship as a driver of innovation

Entrepreneurship is at the heart of innovation. The progress of entrepreneurs is hindered by over regulation of business and fear of failure. The first factor is under the control of government while the second reflects societal attitudes. A cultural change that sees entrepreneurship as a positive innovative force and removes the stigma of failure will support innovation.

B. Local and regional dimensions

National policies articulate global priorities and define main policy instruments. However, it is important that these strategies are implemented at a local level in a way that reflects and takes advantage of particular conditions and circumstances (Box K2.2.). Both the local business environment and specific local framework conditions may have an important impact on the innovation performance of firms located in the region. In addition, local stakeholders need to work together and create working arrangements and links with national policy.

Box K2.2. Are local factors still relevant?

Competitive advantage lies increasingly in local things such as knowledge, relationships, and motivation, all of which factors distant rivals cannot replicate. All of these elements are contrary to the notion that location no longer matters because distances have shrunk and communications are so effective. Policies should be mindful of the importance of these local factors. First, this should concern the choice of the appropriate level for setting targets and applying instruments. Second, attention should be paid to the positive synergies that can be achieved through linkages within and between various locations and the best way to enhance these in a knowledge-based economy.

Partnering at the local level

Economic partnerships at the local level (Box C2.1.) can be established between decision makers from the private, public and voluntary sectors in order to:

- Identify the key challenges in the local/regional economy and act on them by promoting the strengths of the local/regional economy and realizing its potential;

- Promote a better understanding between policymakers and other public sector organizations and private businesses at the local level; and

- Collectively make the case to the national government for greater investment.

Box C2.1. Surrey Economic Partnership – a working example

Surrey Economic Partnership (SEP) is a growing network of senior decision makers from the private, public and voluntary sectors who are keen to have a better understanding of the key challenges facing the Surrey economy and act on them by promoting the strengths of the economy and realizing its potential. Surrey regional economy has a history of success but also faces the problems associated with it. Under ever increasing pressures for development, Surrey needs the government to invest in its infrastructure to ensure the region becomes more globally competitive and productive. SEP is led by business, the wealth creators, but it incorporates the views of a wide range of stakeholders from the public and private sector and the civil society. The SEP has now been established for 10 years and has encouraged a greater mutual understanding between the three sectors, bringing forward more innovative and creative solutions, promoting the importance of economic development to the public in Surrey and collectively supporting local interests at higher levels of government to promote investment in the regional economy and infrastructure.[5]

Any institutional structure created to achieve these aims needs to:

- Have legitimacy in the way it is set up; and
- Business interests should be included as major partners.

One specific arrangement of sharing the future risks associated with the development of a ventures-targeting innovation is the public-private partnership.

Regional innovation policies

The regionalization of innovation policy[6] has a number of positive implications (see also Box C2.2.):

- Innovation policies are bound to have a differentiated regional impact, since innovation processes are not equally spread across countries. Taking into account regional aspects will result in more effective innovation policies;

- Regional differences mean that different strategies and instruments are needed to achieve a given goal;

- Innovation activity is important for economic development and therefore should be part of regional development policies; and

- A variety of regional policies provide opportunities for comparison and benchmarking.

[5] Information available at http://www.surreyeconomicpartnership.org/.

[6] Fritsch, Michael and Stephan**,** Andrea (2005), **"**Regionalization of innovation policy - Introduction to the special issue", *Research Policy, Volume 34, Issue 8*.

Box C2.2. Diagnostic tools and policy assessment for regional policies

Eight projects under the EU's "Regional Innovation Policy Impact Assessment and Benchmarking," have developed practical tools for the systematic assessment of regional innovation policies and strategies[7]. The projects, typically, request information to be inputted in a spreadsheet-type template that allows benchmarking, the definition of policy matrices and provides assessments and guides for action. For example, the focus of INNOWATCH is the development of a tool based on technology watch methodologies specifically applied to SMEs. Another project**,** IMPACTSCAN provides a practical instrument to picture and compare regional innovation policies, with a focus on intermediaries. It highlights regional policy objectives, intermediaries financed by the region, services subsidized by the region and impacts on firms' innovation enablers.

Location and international R&D

Transnational companies (TNC) are a channel for the generation and diffusion of knowledge, in particular, when their activities are directly associated to the creation of R&D centres. Foreign direct investment (FDI) can lead to technology transfer, facilitating the formation of clusters and integration into global value chains. Examples of TNC "facility or greenfield" based investments with a direct impact on innovation, include:

- Manufacturing facilities which may combine with R&D and sales and marketing activities;

- Large R&D centres. These have become fewer over time. But what has become more common is the presence of small research groups of TNCs that have a focus on particular highly advanced technologies;

- Regulatory control centres: The need for regulatory approval of pharmaceutical and agricultural products has resulted in a number of TNC investments in small facilities to undertake this specialist work for their products; and

- Technical sales and support teams that are undertaking market research and technical work in an attempt to increase the global penetration of their products.

What affects location decisions?

TNC decisions on location are influenced by a variety of factors, reflecting:

- The company's strategies;
- The potential development of any subsidiary being considered; and
- The characteristics of the host country or region.

Local features with an impact on location decisions include:

[7] *Source*: www.innovating-regions.org

- Innovation system: The availability of a research infrastructure, including skilled labour, is a critical factor. This includes also the links and degree of collaboration between various knowledge generation organizations. The size of the market is not particularly relevant for TNC that want to build R&D intensive centres with global significance.

- Transport links: Easily accessible locations have an advantage to attract FDI. For example, a TNC may be considering moving its manufacturing facilities to a lower cost region but it is likely that it will retain an R&D presence in a strong knowledge economy. These centres will be developed in locations that can be easily connected by air transport. However, there is a natural tension in this arrangement because locations that have good communications tend to be more expensive and are usually less well supported by local financial incentives than more secondary locations. This suggests that factors other than cost come into play to make a region attractive.

- Presence of other investors: Regions that become 'known' for certain clusters are more likely to attract inward investors that are related to that cluster than those that are not known. The development of a 'brand' or an image for an area can thus be a crucial part of any cluster development strategy, including the attraction of FDI. The presence of a science park may also help create a positive image for an area. The perceived potential for building a technology cluster can be reinforced by marketing and promotion campaigns.

- Infrastructure: The existence of appropriate infrastructure, in a broad sense, including the facility to occupy or rent premises and the availability of other business services. Flexibility of arrangements enhances the attraction of any given location. Public-private partnerships can be used to create the right infrastructure.

- Strategic planning: The presence of well-defined industrial development or regional plans, where FDI plays an identifiable role, can reduce the uncertainty associated with any investment decision and encourage the location of TNC.

Policies to attract R&D-intensive FDI

The public intervention aimed at attracting R&D-intensive FDI (Table 2.1.) is a horizontal policy that results from the intersection of:

- Innovation policy: Improvement of the overall framework conditions for innovation; and
- Inward investment promotion: Building a positive image of the country or region as a location and providing specific support services for R&D-intensive foreign investors.

Table 2.1. A policy framework to attract R&D-intensive FDI

Innovation policy	
	- Fiscal and financial incentives to corporate R&D - Human capital development and attraction of foreign talent - Enhance the research infrastructure and promote collaboration and linkages - Improve the intellectual property rights regime
Inward investment promotion	
	- Target R&D-intensive FDI and build the image of the country as an R&D location - Provide R&D-specific pre-investment and implementation services - Emphasize after-care services - Policy advocacy

Source: Guimón, José (2008), "Government Strategies to attract R&D intensive FDI", paper presented at the OECD Global Forum on International Investment, 27-28 March.

Local research facilities as an attraction element

Most countries already have locations or centres in which there has been significant investment in science and technology and from which a pool of talent has emerged. Examples of these include:

- Military research facilities;
- Large corporate research centres; and
- Government sector-specific research facilities. However, extensive centralized research complexes have been downsized in many countries. Scientific research tends to be conducted on a smaller scale and at a higher level in more diverse locations such as universities.

Land use planning as a factor supporting development

A well-functioning infrastructure plays an important role in the development of a region. In addition, there should be effective structures in place to assist with land use planning at a regional/local level:

- The planning regimes should recognize and value some of the trends in research, development and design. Planners should assist with the changes necessary to support this process.

- Definitions used to determine land use categories need to take into account the synergies that emerge between various types of research based organizations and other activities and avoid constraints in development due to planning restrictions.

Local SMEs and global value/supply chains

Experience in different countries has highlighted several examples where supply chain development has been an important element in building a relationship between large firms and local companies, increasing regional innovation capacity. This experience includes the development of supply chain linkages with overseas companies or original equipment manufacturers, including:

- Supplier certification;
- Buyer/supplier links such as sub-contracting linkages; and
- Strategic alliances.

In terms of their participation in supply chains, SMEs enjoy advantages but also face challenges:

- Flexibility to exploit new opportunities created by the fragmentation of production across complex global value chains and the emergence of new markets is a positive factor.

- Risk of marginalization if they are unable to cope with the demands posed by the globalization process.

- The capacity to finance innovation is a major requirement and constraint for SME participation in global value chains.

Policy areas in facilitating the access of SMEs to global supply chains: [8]

- Awareness-raising of potential participation in global value chains;
- Supplier financing;
- Promotion of technological upgrading;
- Protection of intellectual property;
- Facilitation of compliance procedures;
- Promotion of skills development;
- Attracting foreign direct investment; and
- Promoting the development of industrial clusters.

Practical strategies to support SME participation in supply chains:

- The development of business incubators providing logistical services (such as fax, photocopying and high speed network connections), and low cost office and workshop space;

[8] OECD (2007), Enhancing the Role of SMEs in Global Value Chains, Background Report for the OECD Global Conference, Tokyo, Japan, 31 May-1 June.

- Financial incentives which include reduced property taxes for a fixed period, which frees new businesses from one element of the tax burden;

- Creating an 'Economic Development Service,' and associated information units. This can range from providing information to companies wanting to move to the area right through to organizing meetings and networks with outside companies and potential finance providers. These units can have different objectives (assistance, putting together project proposals or grant aid bids, market-potential studies, communication tools to promote the advantages and skill base of the local area);

- Facilitation of SME consortia for joint marketing or bids, in particular in relation to government procurement;

- Promoting partnerships between SMEs and overseas organizations that can transfer technology or management practices;

- Encouraging the participation of SMEs in standard-setting processes and, when possible, developing group certification for small companies in local regions; and

- Addressing the liquidity problems of SMEs related to the provision of supplier financing, through the development of financial schemes that alleviate the consequences of delays in collecting payments from customers.

Seed-and-breed institutions (Chapter IV) can play a role in fostering supply chain development, in particular business incubators. However, these are not usually core functions for science parks.

Skills base and capacity for innovation

Building a skills base and associated innovation capacity is a long-term strategic endeavour. Entrepreneurial skills are an essential component of the capacity for innovation. An innovative economy requires:

- More highly skilled workers;
- A changing mix of skills adapted to varying economic circumstances;
- A focus on lifelong learning in education and training policies; and
- A reliance on partnerships between education and business, the R&D base and business, and government and business to deliver desired outcomes.

Local dissemination of knowledge

It is now generally believed that with knowledge being more accessible the concept of distance as a barrier to knowledge-based business is reduced. This may well be true; however, this issue is more complex (Box K2.3.).

Box K2.3. Codified and tacit knowledge

Two types of knowledge can be distinguished, according to the degree of formalization:

- Codified knowledge: More accessible and distance is less of a barrier to gaining access to it. Modern electronic communications facilitate rapid dissemination of codified knowledge. This increazes the opportunity for regional variations to be compressed. However, without the presence of the necessary personnel to utilise this codified knowledge, its effective use is limited.

- Tacit knowledge: More limited and more likely to remain local. Tacit knowledge and experience are necessary to understand formal codified knowledge.

Establishing and building competence in tacit knowledge among a community requires:

- Effective communication;
- Building technical knowledge; and
- Knowledge of customers, markets and associated factors such as choice, tastes and fashions.

Local factors are very important in the dissemination of knowledge:[9]

- Social interaction, which is the channel through which knowledge flows, is based on trust and this is more easily established when these interactions take place within proximity.

- The building of a knowledge infrastructure has a clear territorial dimension, with positive effects related to the achievement of critical mass, including the availability of a varied mix of services.

Skills base and innovation capability

There is a clear consensus across business that access to a strong skills base is very important in terms of maintaining a competitive advantage. Those companies that are successful are able to access and nurture a wide range of skills, including those related to:

- Strategic management skills for business leaders;
- Entrepreneurship for graduates;
- Management and production techniques;
- Leadership;
- Mentoring and coaching; and
- Personal development skills.

[9] Simmie, James (2003), "Innovation and urban regions as national and international nodes for the transfer and sharing of knowledge", *Regional Studies*, Vol. 37.

The innovation capabilities of a region depend on a developed skill base that is regularly updated. Initiatives in this area should observe the following principles:

- Focus on the network or cluster, as opposed to being technology-based;
- Emphasise industry specific knowledge;
- Provide crucial links to industry associations;
- Use business not equipment as its context;
- Develop a function as an information repository and information portal;
- Stress staff and curricula (knowledge) in budgets, not bricks and mortar;
- Share curricula and information region-wide and train personnel from other places;
- Identify a lead responsibility for needs assessments;
- Work with network associations on skill standards and certification; and
- Provide out-reach to socially excluded populations.

Skills development through partnerships

Access to appropriate skills (managerial, technical and scientific) is one of the key factors in supporting business development. Coordination between various stakeholders is a necessary condition to identify skill needs and ensure appropriate development. It can take various institutional forms, including the creation of skills and education councils. Coordinated partnership is needed to:

- Provide strategic direction for employment and skills policy in a particular territorial unit. This should be based on evidence of needs for skills that will improve productivity in the existing workforce, as assessed by regional employers.

- Identify, through engagement with employers, skills gaps that can be filled through suitable existing training provision or, where none exists, to work with providers and other partners to create appropriate programmes.

- Facilitate dialogue between all individuals and organizations engaged in education, skills and/or employment by promoting best practice to businesses, support partners and training providers and communicating the priorities, activities and achievements of this partnership to the wider public.

Consultative process on regional skill needs

The main purpose of this process is to assess skills shortages over a range of time horizons in order to plan to meet this through investment in relevant courses or in wider projects such as building competence by establishing a business school or links with one that already exists. The consultative process to determine the regional skills needs involve:

- Representatives of the business sectors in a region, including, for example, human resource teams;
- Representatives of business support agencies;

- Providers of qualified staff at secondary, further and tertiary sectors, including careers departments from educational institutions among others;

- Representatives of the workforce; and

- Members of community groups.

The importance of functioning networks

Cooperative networks enable the formal and informal flow of knowledge through their members and create the basis for partnerships. Networks can:

- Have a well-defined geographical dimension, as in the case of clusters; or be based on sectoral interests.

- Emerge naturally, as a result of common interests, since they deliver real value to participants. The formation of these networks is a slow process.

- Be supported by emerging institutional structures such as Chambers of Commerce, entrepreneur clubs or equity capital groups. These arrangements can provide stability and accelerate the development of networks.

The importance of networks has been increasingly recognized in innovation policies:

- Networks can reduce the effective risk of innovation for the individual firms, as this is shared with other entrepreneurs.

- In networks organized along geographical lines, proximity encourages the rapid exchange of information. This, together with trust, rivalry, and extensive outsourcing arrangements ensures that innovations in individual firms upgrade the overall cluster.

Public policy and networking

The social benefits of a network may be substantial but the private costs for some participants may exceed private benefits. Therefore, there is a role for public involvement in the formation of networks.[10] Public intervention can help in addressing issues that emerge at various stages of the networking process, in particular:

- Awareness of a networking possibility;
- Search for partners;
- Building trust and a shared knowledge base;
- Organizing the network;
- Ensuring complementary resources; and

[10] Polt, Wolfgang (2001), "The role of Government in networking" in *OECD, Innovative Networks. Co-operation in National Innovation Systems*, Paris.

- Active cooperation in the activities of the network.

Some lessons can be drawn from recent practice in public programmes supporting networks:

- Presence of a formal organization structure: This is meant to encourage the formation of a long-term sustained relationship that supports mutual trust. Informational resources can be provided by the public sector to promote these structures, but concrete arrangements should be left to the participants.

- Bottom-up support: Programmes that support existing or emerging self-organizing networks (a bottom-up approach) tend to give better results than those that reflect "top-down" technological priorities.

- Long-term: Building trust takes time; so long periods of support and institutional stability are essential. Insufficient coordination of initiatives and a volatile funding and institutional setting are particularly damaging for network-oriented policies.

- Tailor-made: Programmes need to take into account the different needs, incentives and capabilities of participants. This implies, for example, paying particular attention to the needs of SMEs.

C. The role of the business environment

The different dimensions of the business environment have a significant influence on the formation of new companies and their ability to develop innovative, risky activities (Box C2.3.). Where the burden of bureaucracy is low, there is a higher business formation rate and better opportunities for business development. Removing bureaucratic barriers to the formation and operation of enterprises (including employment legislation) would have a positive impact on innovation.

Box C2.3. Good practices in company formation[11]

Portugal
The initiative "On-the-spot firm," or "Empresa na Hora," represents an effort to concentrate procedures for the creation of a company in just one office. It is a special system for creating companies that allows firms (private limited companies, partnerships or PLC), to be set up by making a single trip to just one office (Business Formalities Centre or the Commercial Registry Office). The average time to create a company in Portugal is 48 minutes. An Internet domain name and an electronic address are immediately available to each firm created by this system.

In operation since July 2005, in six offices as a pilot scheme, this new service was made available all over the country in February 2006. The service has already 82 counters across the country and will soon feature new counters. More than 40,000 companies have been established on-the-spot since the service was launched on 14 July 2005.

Estonia
It is possible since 2007 to register a company in the commercial register via the Internet. This kind of accelerated registration procedure is available to individual entrepreneurs, private limited companies, general partnerships and limited partnerships. The expedited registration procedure is an alternative to ordinary registration (from 2007, the usual procedure time will be five working days on the basis of law). All required documents, including the petition, shall be submitted to the registration department of a court via the Internet using digital signature. The notarized memorandum and articles of association of a private limited company will be replaced by a special type of memorandum of association whose format and contents are provided by legislation. The information system verifies the submitted data and documents automatically. In the future, the possibilities to make use of the expedited procedure will be extended even more.

Austria
The start-up portal of the Vienna Economic Chamber provides general information on starting a business. It also gives free personalized advice on a number of topics, including assessment of a draft business plan. Businesses can register online at the offices of the Chamber. The information is sent to the relevant authorities, thereby linking them in a network. The system results in savings in time and money (one-stop-shop for all start-up companies), removal of administrative obstacles, legal certainty for those starting a business and provides free legal and financial advice from neutral sources.

Policy instruments can be specifically devised to target specific components of the business environment to assist the development of innovative enterprises.

Business support services

These have a general significance, providing support for entrepreneurs wanting to create businesses. Some of these specialize in small businesses, some in sector specific activities and others in general businesses. Typically, advice and support is granted in a number of different areas, including:

[11] *Source*: Contribution by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies (Portugal) and the European Charter for Small Enterprises. Good Practices Selection, 2007.

- Starting up;
- Finance and grants;
- Taxes, returns and payroll;
- Employing people;
- Health, safety, premises;
- Environment and efficiency;
- Ideas development;
- IT and e-commerce;
- Sales and marketing;
- International trade;
- Growing the business; and
- Business transfer.

Typically, the provision of business support services should be preceded by a needs assessment. This in itself is a specific business service (Box C2.4.).

Box C2.4. Diagnostic and assessment tools[12]

Portugal
The INOVAR Platform is an integrated diagnostic and evaluation system to determine a company's innovative potential. The need to evaluate a company's performance and identify and act on its factors of success is what gave birth to the INOVAR Platform. These diagnosis and decision making tools are made available to businesses. This instrument includes a set of on-line questionnaires and associated services and can be used to measure the Portuguese companies' potential, at national and international level, namely concerning competitiveness, innovation and exports, enabling the performance potential self-diagnosis of performance potential and identifying critical areas for development. The Plataforma INOVAR allows for the integration of three compatible tools, offering companies a more complementary approach:

1. On-line Innovation (a self-diagnosis assisted benchmarking);
2. Benchmarking and Good Practices (Portuguese Benchmarking Index); and
3. Innovation Scoring.

France
ADEPA, a non-profit organization which promotes advanced technologies to improve industrial performance, and the French National Bank have used the GIPSE tool which is particularly adapted to SMEs to establish a diagnostic system for the industrial, economic and financial aspects of a company and to evaluate and grade them. By measuring 40 numeric indicators, the company's position in seven strategic sectors, which represent major challenges to its performance, is indicated. This diagnosis of industrial performance makes it possible to benchmark a company within its area of activity and to propose hierarchical organizational patterns and action plans developed with the company management team to improve performance. A software package allows the impact of these action plans on economic and financial aspects to be simulated on a multi-year basis.

[12] *Source*: Contribution by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies (Portugal), www.improve-innovation.eu.

Four reports are presented to management on: strategic analysis, diagnosis of industrial performance, economic and financial assessment, proposed evolution scenarios and action plans.

European Commission
IMP³rove is as a European INNOVA initiative to encourage SMEs to develop and improve their innovation management capabilities. An on-line tool allows companies to assess their current capabilities. Once they have benchmarked their own performance against that of counterparts, IMP³rove offers them a consultancy service to improve their innovation management performance.

Advisory/coaching services on innovation

Most businesses recognize the importance of innovation as a major driver of success. However, the skills required for innovation management both at the operational and strategic levels are quite different to those required for normal business administration. This may require specialised advisory services that go beyond those that cater for general business development needs, providing specific access to resources and advice on innovation. The task of these specialised services should be to:

- Link companies to the regional and national knowledge base of universities and research institutes;
- Help companies to access resources for innovation;
- Help companies to identify major growth opportunities;
- Improve the levels of innovation and competitiveness in small and medium sized companies; and
- Provide advice on funding opportunities.

Advisory services should have appropriate technical and business backgrounds to assist companies in developing competencies related to the development and management of innovation. The Innovation Advisory Service (IAS) funded by the South East England Development Agency in the United Kingdom is an example of this type of service. An Animate Methodology programme has been devised by IAS and Oxford Innovation. This programme allows businesses to progress from diagnosis and strategic analysis to practical action plans to support best practice in innovation. Details are set out in Annex I. More country experiences in providing advisory/coaching services on innovation are given in Box C2.5.

Box C2.5. Business support services for innovative firms[13]

Poland

The business support system is based on the cooperation of partners at three levels of activity: national (Polish Agency for Enterprise Development), regional (Regional Financing Institutions), and direct service providers. The National SME Services Network (KSU) has been in operation since 1996 and includes over 180 centres cooperating in 190 locations in Poland. The network consists primarily of regional and local development agencies, business support centres, chambers of industry and commerce, and local non-profit foundations and associations, which provide services directly to the SME sector. This is an open system in which new centres join each year. As part of this network, the National Innovation Network (KSI) provides advisory services on innovation. The objectives of the National Innovation Network comprise assistance in the creation of conditions for transfer and marketing of new technological solutions and implementation of innovative undertakings in the SME sector. Consultation Centres (PK) function as first-contact institutions for small and medium-sized enterprises. In 2007, around 190 centres were in service. PKs provide free-of-charge information services with respect to issues associated with entrepreneurial activities and enterprise management. The role of a PK advisor is to identify the available assistance programmes and to provide detailed information as to the conditions for the granting of assistance.

Czech Republic

CzechInvest supports the development of a Regional Information and Consulting Infrastructure. The goal is to ensure information services and provide favourably priced consulting and education services in the greatest possible number of locations in the Czech Republic. The aim of the information services will be to provide basic information on support for small and medium-sized enterprises, professional seminars, and education activities, as well as information on the products of the Czech-Moravian Guarantee and Development Bank, products of European Union structural funds, and other activities of concerned institutions and bodies of the Czech Republic. Another integral part of this system will be the provision of favourably-priced consulting and education services that selected consulting firms in the Czech Republic will provide to parties interested in conducting business, new entrepreneurs, and entities already engaged in business.

United Kingdom

The United Kingdom has a well-developed and extensive business support infrastructure. The central objective of Business Links is to improve the competitiveness of small firms through more comprehensive provision of business support, reaching small firms and rationalizing activities to avoid duplication. There has been an ongoing trend to improve coordination while at the same time devolve the management of this infrastructure to regional development authorities. This reorganization seeks to ensure better access to relevant expertise that is tailored to the individual needs of local, innovative businesses. One of the important objectives of Business Link is to facilitate collaboration between businesses and other actors with a view to implementing joint innovation activities.

The need for a differentiated approach

The design of a programme of support needs to take into account:

[13] *Source*: Contribution by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies (Poland), www.businesslink.co.uk, www.czechinvest.org.

- The distinctive needs of SMEs;
- The sector to which they belong; and
- The characteristics of the region in which they operate.

A taxonomy of firms can be established on the basis of the sources of innovations and their technological dynamism (Table 2.2.). Policies should be tailored to offer services that correspond to the actual needs of the companies, including choices regarding the appropriate level for setting these objectives and delivering the services (national/regional/local).

Table 2.2. Typologies of industries and needs/demands of services in the innovation process

	Science based	Fundamental Processes	Complex know-ledge system	Product engi-neering	Tradi-tional industries
Density of SMEs and needs of entrepreneurial assistance	1	1	1	5	5
Speed of technological change	5	2	3	3	1
Needs of in-house R&D	5	3	5	2	1
Need of strong scientific research	4	3	3	1	1
Need of strong applied knowledge	3	5	5	4	4
Need for IPR regulation	5	3	5	2	1
Need for support in scanning the technological environment	1	3	2	4	5
Lack of awareness of technological needs	1	3	2	3	5
Need of higher education	5	3	3	2	1
Need of firm specific innovation support	2	4	2	4	5
Need of generic technological infrastructures	2	4	3	4	5

Note: 1:= not important, 5:= very important.

Source: Archibugi, Daniele and Orsenigo, Luigi, "The problems and needs of innovation in a typology of industries/ technologies", in INSME (2003), *A methodological approach for the identification of SME innovation policy instruments.*

What works in business services provision?

There is a considerable wealth of experiences regarding the public provision of, or support for business services. Despite the diversity of business cultures and economic structures that affect the design of these services, they typically need to address issues such as:

- Decentralization: Business services need to be close to their customers to be effective, but an extensive network imposes costs, so alternative delivery methods can be explored.

- Coordination: Business services can be a gateway to access information and support institutional collaboration with other organizations, such as Chamber of Commerce, regional enterprise agencies or even consulting companies. However, the coordination role may be detrimental to the acquisition of specialised expertise.

- Cost bearing: Free services increase potential reach. However, good quality business services are expensive, so contribution to costs can be an option. Paying for the services is also a check on the quality of what is being delivered.

- Learning: The institutional set-up needs to put in place flexible arrangements that allow customer input in the design and implementation of programmes of support in a dynamic way. Knowledge gained in interaction with customers should be transferred across the organization, but bearing in mind that specific local solutions cannot always be replicated.

The experience of different countries has served to identify some general principles for good practices in the organization and delivery of business services (Table 2.3.).

Table 2.3. Basic principles in the organization and delivery of business services

Client Orientation	Putting service to the client as the overriding principle.
Comprehensiveness	Ensuring enterprises have convenient access to all the services they need.
Coherence and Rationalization	The provision of complete and coherent packages of services that cover all the management functions. In some instances, this requires the integration of the services already allocated to one-stop shops.
Targeting	Coherent packages of services, employing a common methodology, must nonetheless be differentiated according to client groups.
Use of ICT	The use of ICT can not only revolutionize the delivery of services, especially information provision, but also have a major impact on the nature of the services provided.
A Strategic Approach	A strategic approach is often more appropriate both in relation to the role of support organizations and to the advice given to enterprises.
Coordination	Achievement of coherent and well-targeted services requires a high degree of coordination, mainly at the regional level.
Quality	High service delivery standards.
Professionalism	High quality services need high quality professional staff to deliver them.
Top-class Resources	Efficient advice and (especially) information services require appropriate resources, notably in the IT area.
Effective Promotion	Even the best services are of limited value if they are not known or fully utilized, by the target population.
Evaluation	More extensive and rigorous evaluation of initiatives, to see if they really work and how cost effective they are.

Source: Analysis of Good Practice. Top Class Business Support Services, 2001, available at http://ec.europa.eu/enterprise/entrepreneurship/support_measures/support-services/analysis_of_good_practice_en.pdf.

Fiscal instruments

Research and development activities carried out by companies (Box K2.4.) benefit in many countries from a favourable fiscal treatment. In addition, public resources can be used for direct funding of R&D projects.

Box K2.4. What is R&D and why it matters?

R&D can be defined as any project to resolve scientific or technological uncertainty aimed at achieving an advance in science or technology. Advances include new or improved products, processes and services. In practice, definitions may vary in different countries to qualify for specific tax allowances. International research has consistently demonstrated the positive correlation between R&D investment intensity and company performance measures such as sales growth and share price in the sectors where R&D is important. Businesses are in a better position to achieve and maintain competitive advantage in the increasingly global market place with sustained R&D and other related investment at the right levels.

R&D tax incentives

The objective of this policy instrument is to encourage business R&D providing financial incentives through the tax system. There are different types of R&D fiscal incentives that can be used. These can be classified as:

- General: They are granted to all companies under certain conditions.
- Specific: They depend on obtaining a certain status as a R&D company. This status is usually contingent on a certain threshold on the share of revenues from research and development services over total income. Fiscal incentives may also be limited to small enterprises.

These incentives specify:

- The specific type of expenditures covered (all innovation expenses/only R&D, in-house or external, including foreign; cost of patents);
- Any differentiation of rates. Typically, systems are more generous for basic research and less for development;
- The limits for any possible deduction (absolute or in relation to an identifiable benchmark);
- The modalities of certification of expenditures by the authorities (in advance or subject to review); and
- The time period for the application of the deduction.

Tax incentives can take the form of:

- Credits: Reducing the amount of taxes to be paid;
- Allowances: Reducing the tax base for the calculation of corporate earnings.

There are some generally accepted principles in designing R&D tax incentives (Table 2.4.).

Table 2.4. Principles of designing tax incentives for R&D in firms

General principles	Incentives should be transparent and easily accessible to a broad range of firms. The nature and basis of incentives should not change too frequently.
General versus selective measures	General measures reach more firms, maximizing the potential increase in R&D and minimizing market distortions. Targeted measures are best used to reinforce technological leadership or build critical mass, but must be carefully designed to avoid distortion of the market.
Types of regime	Where there is a relatively stable market demand for R&D, volume-based incentives are best. Where there is a specific policy objective to support dynamic firms, increment-based incentives are best. Both can be combined in one tax incentive.
	To increase the number of employees engaged in R&D or to support firms which are unlikely to make profits in the short term, tax incentives to reduce the cost of employing research personnel are particularly apt.
Types of relief	The full cost of R&D expenditure should be capitalized and depreciated over a period of time if it is decided not to allow the full cost of R&D expenditure to be taken to the fiscal profit and loss account.
Level of generosity	A rate should be set which is both sufficiently attractive and sustainable in the long run.
Eligible R&D costs	R&D current expenses (e.g. personnel costs), should be fully deductible as part of the general tax treatment of R&D.
	Make certain types of R&D-related capital expenditure (e.g. infrastructure and equipment), at least partly deductible.

Source: Adapted from, "Towards a more effective use of tax incentives in favour of R&D", accessed at http://www.bis-rtd.net/documents/deliverables/workdoc_tax_incentives_en.pdf.

Notwithstanding these principles, the experiences of different countries in applying R&D tax incentives may vary considerably (Box C2.6.).

Box C2.6. R&D tax incentives[14]

United Kingdom
All companies with qualifying spending over £10,000 a year on R&D are entitled to a deduction when calculating their taxable profits of 150% of qualifying expenditure for SMEs or 125% of qualifying expenditure for larger companies, reducing the company's UK corporation tax bill accordingly. The rate of relief under the large company scheme will increase to 130% for work undertaken on/after 1 April 2008. European Commission approval is being sought to increase the rate under the SME scheme to 175%. Companies can claim R&D Tax Credits for their expenditure on direct or indirect employment of staff, consumable materials and utilities directly and actively engaged in carrying out R&D. Figure 2.2 illustrates the design of the fiscal treatment of firms' R&D spending in the United Kingdom. It helps to identify whether a company undertaking one R&D project is likely to be eligible for R&D tax relief or R&D tax credits in the UK.

Ireland
Ireland introduced in 2004 a new R&D Tax Credit, which was designed to encourage both foreign and indigenous companies to undertake new and/or additional R&D activity in Ireland. The tax credit is available to Irish tax-resident companies engaged in in-house qualifying R&D undertaken within the European Economic Area [EEA], if this expenditure is not eligible for tax benefit elsewhere within the EEA. In practice R&D expenditure covers wages, related overheads, plant and machinery and buildings. The 2007 Finance Act fixed the base year against which qualifying incremental expenditure on R&D is measured at - 2003 - for a further three years to 2009. This will provide an additional incentive for increased expenditure on R&D in 2007, 2008 and 2009. In addition, from 1 January 2007, companies that sub-contract R&D work to unconnected parties will also qualify up to a maximum of 10% of the qualifying R&D expenditure in any one year.

Israel
The tax code in Israel allows firms to deduct qualifying R&D expenses (including outsourced R&D), from taxable income in the same year, after the claimed expenditure has been approved by the OCS. The use of this clause is not widespread, although some firms are using it rather 'creatively', claiming all sorts if deductions, including sabbatical expenses of their employees abroad. There is no tax credit as such.

Russian Federation
Russian legislation has established a number of tax privileges for firms' R&D expenditures. Before 2007, R&D expenses up to 1.5% of the company's turnover were to be considered as tax deductible. In 2007, this ceiling was abolished meaning that all R&D expenditures can be deducted when calculating taxable profits. Federal R&D Foundations are not subject to profit tax and VAT at all. In addition, company assets obtained from particular scientific and technology support funds are not considered as income. If a company's fixed assets are used exclusively for scientific activity, the basic depreciation rate can be increased.

Spain
The Spanish R&D tax incentives system has traditionally been one of the most generous among UNECE countries. Despite this, only around 30% of enterprises benefit from these incentives. Recent reforms have sought to reduce bureaucratic barriers to access R&D support. Since 2007, there has been a shifts towards a reduction of the deduction percentages applied to R&D expenditures while allowing deductions of up to 40% of social security payments for research personnel employed for R&D and innovation expenditure. This shift is expected to be more adadvantageous for new companies.

[14] *Source:* documents submitted by members of the UNECE Team of Specialists on Innovation and

The consideration of R&D for tax purposes is usually dependent on the significance of this activity for the overall advance of science and technology:

- It must have general relevance beyond the company that is incurring the expenditures.
- The use of science or technology does not imply necessarily that the process, material, device, product, service or source of knowledge is an advance in science and technology.
- It may include the adaptation of existing knowledge or capabilities, as far as it is considered as an advance.

Competitiveness Policies; www.berr.gov.uk;www.idaireland.com; INNO-Policy TrendChart- Policy Trends and Appraisal Report. Spain, 2007.

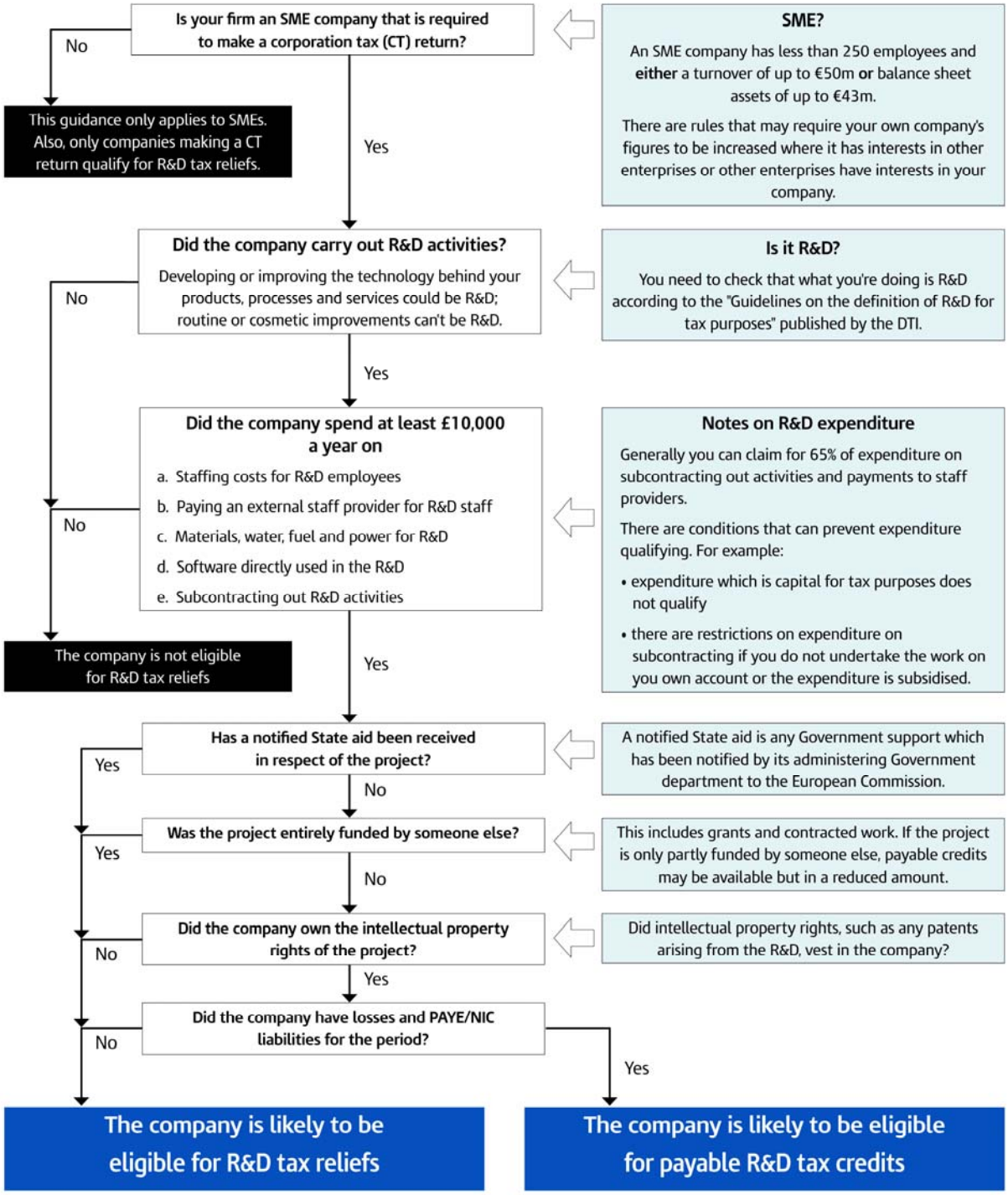


Figure 2.2. Eligibility of UK companies for R&D tax incentives

Source: HM's Revenue and Customs, 2008.

Direct public funding

The provision of public resources for financing specific R&D projects may be pursuing policy aims distinct from the promotion of innovation, although some positive spillovers can result (Table 2.5.). These projects may be administered by a variety of public bodies.

Table 2.5. Direct funding and tax incentives for R&D

Criterion	Policy instrument	
	Direct funding	**Tax incentives**
Effectiveness in boosting levels of business R&D.	Varies depending on selection criteria, design, and capability of administrators.	Generates R&D in excess of lost revenue.
Ability to target industries/sectors.	Good. Government can establish criteria.	Limited. Some targeting of SMEs.
Ability to influence business R&D behavior.	Can affect collaboration, management of R&D.	Limited. Can encourage increased R&D investment.
Selection of projects.	Government selects among industry proposals.	Industry decides without intervention.
Administrative costs.	High, need to establish bureaucracy.	Low, but hard to estimate. Enforcement costs vary.
Government skills needed.	Strong skills in selecting projects, managing programme.	Effective, efficient tax administration.
Scope of participating firms.	Limited to selected firms.	All R&D-performing firms, but special regimes may exist.
Summary	Good for building R&D capacity in specific sectors, concentrating resources. Incremental and radical innovation.	Good for providing basic financial incentive/reward to business; incremental innovation.

Source: Adapted from Jerry Sheenan, Incentives and Support Systems to Foster Private Sector Innovation, presentation at the Science, Technology and Innovation Network IADB Regional Policy Dialogue, 16-17April 2007.

Ease of access to finance for early-stage companies

Entrepreneurs trying to transform new ideas into compelling commercial propositions face significant challenges in raising finance at the very early stages of development of a company. Venture capital financing cannot be relied on as an initial source of financing:

- Venture capital is not a source of funding for the proof of concept or seed stages. It only comes into play when the company achieves a certain minimum size.

- A "deal flow" that provides potential investment opportunities for venture capitalists can only emerge if the financing needs of companies are addressed at an earlier stage, so as to make possible their development to more mature phases when other sources of funding become available.

The market failure in early-stage financing has been widely recognized and has prompted the emergence of a variety of policy interventions seeking to address the financing problems of early-stage companies (Box K2.5. and Figure 2.3.).[15]

Box K2.5. Addressing bottlenecks in early-stage financing

A key principle to observe when designing interventions in the area of early-stage financing is that policies should consider the various phases in the development of a company and their impact on financing needs. Focusing on a particular phase without due consideration to the financing difficulties that may arise earlier or later would only displace the problem without fully addressing it.

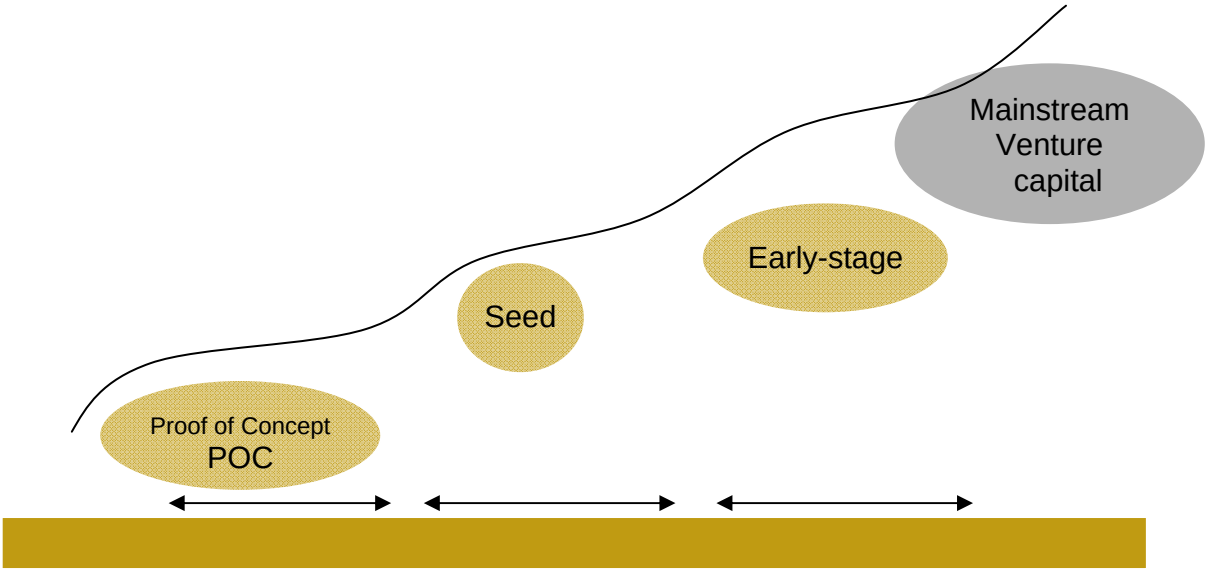


Figure 2.3. Funding requirements lifecycle

[15] For more details see UNECE, Financing Innovative Development. *Comparative Review of the Experiences of UNECE Countries in Early-stage Financing*. Geneva and New York, 2007 and UNECE, Policy Options and Instruments for Financing Innovation: A Practical Guide to Early-Stage Financing. Geneva and New York, 2008.

Modalities of intervention

These may include:

- Grant financing: This may be provided by different authorities, sometimes not in connection with innovation-related objectives but pursuing regional development strategies. The provision of resources may be monetary or may take the form of access to specific business services. In addition, some requirements regarding co-financing may be imposed.
- Guarantees: This allows businesses without sufficient security for commercial bank lending to obtain loans from participating banks that are guaranteed by the government, at least partially.

- Business angels support: Business angels are private investors who invest directly in private companies in return for an equity stake and perhaps a seat on the company's board. Business angels make more and smaller investments than venture capital firms and are more active in the early stages of development. Interventions in this area can:

    - Facilitate the dissemination of information and communication between business angels and companies; and

    - Provide fiscal advantages to business angels investing in small unquoted companies. An example is the UK Enterprise Investment Scheme, which limits the liabilities from capital gains taxes arising from successful investments.

- Public or public-private venture capital fund: Funds invest in early-stage companies. In some cases, management is fully private while public resources are used to change the risk-reward ratios for private investors and encourage investments in early-stage companies.

Table 2.6. provides an overview of the different types of intervention to support early-stage companies.

Table 2.6. Taxonomy of types of support for early-stage companies

Type of programme	Description	Example
Public fund	100% publicly owned funds focused on pre-seed and/or seed stages	Twinning Growth Fund and Biopartner (The Netherlands)
Public/private equity fund	Fund in which government and private sector co-invest with same focus as previous	University Challenge Funds (UK); Technologiebeteilungesellschaft (Germany)

Type of programme	Description	Example
US Small Business Investment Company (SBIC)-type of refinance schemes	Schemes which leverage the deals made by adding public money to the private investment	Arkimedes (Belgium); SBIC (USA); Kreditanstalt für Wiederaufbau (Germany)
Guarantee schemes	Insurance schemes which guarantee (part) of the VC money in case of bankruptcy	Various, in each country
Fiscal incentives	Tax reduction schemes on value added or income tax deduction	Aunt Agaath Scheme (Nl); Banque de Développement des PMEs (France); Trust Capital Funds (UK)
Incubation scheme	Scheme which pays the salaries of coaches, which offers facilities and/or which offers network opportunities	National Incubator Programme (Sweden); DIILI Programme (Finland); Innovationsmiljoer (Denmark); Exist (Germany); Les Incubateurs Publiques (France)

Source: Wrigth, Mike et al. (2006), University Spin Out Companies and Venture Capital, Research Policy, Vol. 35, Issue 4.

Intervention in the area of early-stage financing can focus not only on the supply-side (the provision of financial resources), but also on the demand-side. Entrepreneurs can be supported in their efforts to become "investment ready", thus facilitating acquiring external sources of financing. In addition, networking between investors and entrepreneurs can be encouraged. Box C2.7 contains examples of country experiences in early-stage financing.

Box C2.7. Country experiences in early stage financing[16]

Poland

The Polish National Capital Fund (NCF) Joint Stock Company started its activity in June 2007. The NCF is a fund of funds that supports PE/VC funds that invest in small and medium companies based in Poland and focus on innovative, R&D and high-growth projects. NCF investments are either equity investments or long-term debt financing. Additionally, NCF offers grants to cover part of the costs of preparing and monitoring a fund's investment portfolio. The funding mechanism of NCF assumes preferential treatment of investors who co-invest in NCF portfolio funds along with NCF. By the end of 2007, NCF had signed investment agreements leading to the creation of two venture capital funds. The two funds have a joint capitalization of PLN 100 million.

[16] *Source*: Contribution by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies (Poland, Portugal, Russian Federation).

Portugal
Portugal launched the FINICIA programme at the beginning of 2006, which is focused on business start-ups and innovative small companies. It started as an Access to Finance Scheme and evolved into a holistic approach to the entrepreneurs' detected needs, in terms of business planning support, financing schemes and management skills reinforcement. This business approach implicated a comprehensive network that includes IAPMEI (Institute for Medium and Small Enterprises Support and Innovation), Universities, Regional Authorities and Financial Institutions. FINICIA aims to create a local support network, bringing together through regional platforms, the supply and demand sides of venture capital financing and all the entrepreneurship development major players. These Regional Platforms seek to encourage innovation and entrepreneurship and facilitate technology transfer. The platforms include on the demand side: Universities, Incubators, Development Agencies and other regional partners, and on the supply side: Venture Capital Companies, for finance and support to emergent start-ups. During its implementation, 13 FINICIA regional informal networks have been created.

Russian Federation
The Foundation for Assistance to Small Innovative Enterprises (FASIE), manages the START programme, providing support to around 400 start-up projects per year originated in public research institutions. Matching private investments is required for the continuation of initial assistance. More than 25 regional venture funds have been created with 25% of investments from federal budget, 25% from regional budgets and 50% from private sources. The size of the funds ranges between $80 million and $400 million. The largest initiative is the Russian Venture Company, a fund of funds to which $1 billion of federal money has been allocated. Two venture funds ($100 million) have been formed so far under the RVC, with a state participation of 49%.

The policy instruments used for such intervention include:

- Consultancy and training courses (searching for investors, understanding the implication of various types of financing, preparing documentation);

- Exchange of experiences between investors (including conferences, seminars and workshops);

- Promotional and informational projects aimed at increasing the entrepreneur's awareness of benefits and services offered by investors' networks; and

- Creation, development and functioning of platforms associating investors and entrepreneurs who search for financing and training projects for potential investors, including business angels.

III. STRENGTHENING INDUSTRY-SCIENCE-EDUCATION LINKAGES

Executive Summary

- *The innovation process requires a connection between the institution's generation of knowledge and those organizations that address the market, that is, between education/science and business. For these linkages to be effective the knowledge needs to be relevant and business needs to know how to use the knowledge.*

- *Effective management of the links between the production of knowledge and skills and their utilization and commercialization is essential for the development of a sustainable knowledge and innovation base in any economic system. Sustainable education – science – industry linkages are essential for delivering skills and technology to the market place.*

- *These linkages are weak in many UNECE countries, especially in some of the catching-up economies. Among the causes of poor linkages are the inadequate institutional infrastructure of the NIS, legacies of the "linear" model of innovation, old-fashioned courses taught in universities that lack relevance in the commercial domain, and the traditional weaknesses of the NIS in the catching-up economies inherited from the period of centrally planned economy. It is essential that such gaps be close, which may require targeted policy interventions.*

- *Closing the gap between the needs of business and the educational/R&D output of the NIS requires close collaboration and dialogue between the relevant stakeholders. Policy interventions may also enhance connectivity and cooperation among stakeholders.*

- *Various publicly funded programmes have been developed to assist in this process in different UNECE countries. On the one hand, such programmes generally target enhancing the exposure of academics and students to the commercial sector including staff exchange, as well as technology and knowledge transfer. On the other hand, policy measures aim at reducing obstacles and barriers that may discourage the business sector from drawing on the intellectual resources of academic centres.*

- *In addition, policy may support strategy groups in aligning public programmes with the needs of industry. Examples of such strategy groups include science and industry councils and technology strategy boards. To be effective, representation on these committees needs to cover the interests of business, education and the organizations that deliver the services from one side to the other.*

- *At the regional level, some regions establish learning and skills councils that actively engage with the problem of increasing the number and strength of linkages between education and industry.*

- *Universities may be encouraged to adapt management and education structures to sustain links with the business sector. Examples of these include increased mobility between academia and business; project management support; support in the management of intellectual property; cooperation in developing educational modules, etc.*

- *More generally, the role of universities is now changing as there is an increasing expectation on them not only to contribute to developing and passing on new knowledge but also to take an active role in developing their communities and local business.*

- *Management structures in universities to support these programmes may include units such as technology transfer services, specific legal services in negotiating contacts and in protecting intellectual property; research and business services; liaison officers assisting relations with businesses, etc.*

- *Other outreach programmes that are aimed at strengthening the links between education and industry include establishing innovation clubs and bodies offering research advice services. These programmes target establishing direct links among potential stakeholders from both the academic and business communities.*

A. Identifying industry-science linkages and the forms of public support

The role of industry-science linkages

Linkages between knowledge production and knowledge utilisation are at the heart of any innovation system. The efficiency and success of such linkages depend on the willingness of both sides of the process to collaborate. The need to work together has long been recognized by forward thinking businesses and universities. However, it is only relatively recently that industry-science linkages have become an explicit target of public policy (Box C3.1.), which traditionally used to focus on the “linear” models of innovation. With the latter becoming increasingly obsolete in the modern knowledge-based economy, policy has started to devote more attention to the systemic nature of innovation.

Box C3.1. Public programmes supporting industry-science linkages

United States[17]
The SBIR is a public-private partnership that provides grants to fund private R&D projects in small businesses. The Small Business Innovation Development Act of 1982 created the foundations for these long-standing programmes. One of the objectives is increasing private sector commercialization of innovation derived from Federal R&D. There are two types of awards:

Phase I – assist businesses to assess feasibility of an idea's scientific and commercial potential.
Phase II - assist the business to develop further its research, ideally leading to a commercially viable product, process, or service.

The National Academy of Sciences conducted a congressionally mandated evaluation study of the programme on the basis of large sample of data for the period 1992-2001. One of the conclusions of the study was that success in commercialization is associated with the involvement of a university or public research organization in the project.

Denmark
The Innovation Consortium Programme was initiated in 2002, being a continuation of the Centre Contract Programme set up in 1995. Through these arrangements, the Government has been providing support for project cooperation in consortia involving enterprises, research institutions and technological service parties with a view to developing knowledge and competences (technology platforms) that can form the basis for product and service development by Danish businesses within a time frame of five to ten years. A 10-year evaluation of these programmes found out that most of the consortia resulted in an acceleration of the innovation process or were a prerequisite for producing the technologies. Case studies suggested that new innovations and knowledge dissemination took place several years after consortia have ended. However, the involvement of SMEs has been less satisfactory.

Spain: Institutional basis for industry-science collaboration
The University-Company Foundations are private entities with a regional scope that are formed as joint initiatives by universities and companies. They provide support for university-industry relations in three main areas: innovation and technology transfers, specialised training for universities and companies and, especially, mobility of students and graduates between companies and universities within Europe.

Linkages as amplifiers of the effect of public policy

It has been identified that efficiency of public policy in support of innovation increases significantly it if supports both the supply of and demand for innovation. Moreover, in this context, efficient industry-science linkages can act as amplifiers of the effect of public policy measures.

- On the supply side, the level of support (e.g. in the form of government intervention with grants or tax relief), varies from a relatively high level for basic R&D through to

[17] *Source*: Presentation by Al Link (United States) to the second session of the UNECE Team of Specialists on Innovation and Competitiveness Policies; Inside Consulting and Oxford Research (2005), Evaluation of the Centre Contract/Innovation Consortium Programme.

none at the point where a product meets the market at which point all of the risk is carried by the investor. Between these two points there is a sliding scale of diminishing government intervention and increasing investor risk as ideas are moved from basic research, through applied R&D, demonstrators, commercialization, market development and diffusion into the market.

- On the demand side of the process there is also recognition of the need to build relationships with the knowledge base in order to innovate; however, the availability of the necessary financial and human resources to create these linkages and the level of understanding of how to achieve this is not uniform across business.

This role of industry-science linkages is illustrated in Figure 3.1.

It is against this background that a number of industry-science-university programmes have been developed in order to improve the rate of commercialization of technology. Among these are programmes that are aimed at the early stage of the process while others are offered on the basis of dealing with products that are closer to market.

Forms of industry-science collaboration

Collaboration between public research, educational institutions and industry can take many forms (Table 3.1.). These linkages have a direct and indirect impact on the innovative capabilities of firms. Public programmes in support of such linkages can also take various forms: some are available as grants, some as grants that are given as matched funding and others still that are bid based as R&D contracts for government (see also Box C3.1.).

As previously noted the funding gap that exits for commercialising technology is very real and a constraint on the innovation process. The importance of funding programmes to progress technology should not be underestimated as these:

- Give incentives to encourage industrial orientation of R&D;
- Assist with assessing the proof of concept, viability and scalability of products;
- Increase innovation capacity by allowing many more organizations to bring forward technology for commercialization; and
- Improve access to the supply side of the equation, particularly for SMEs that traditionally have not linked with universities.

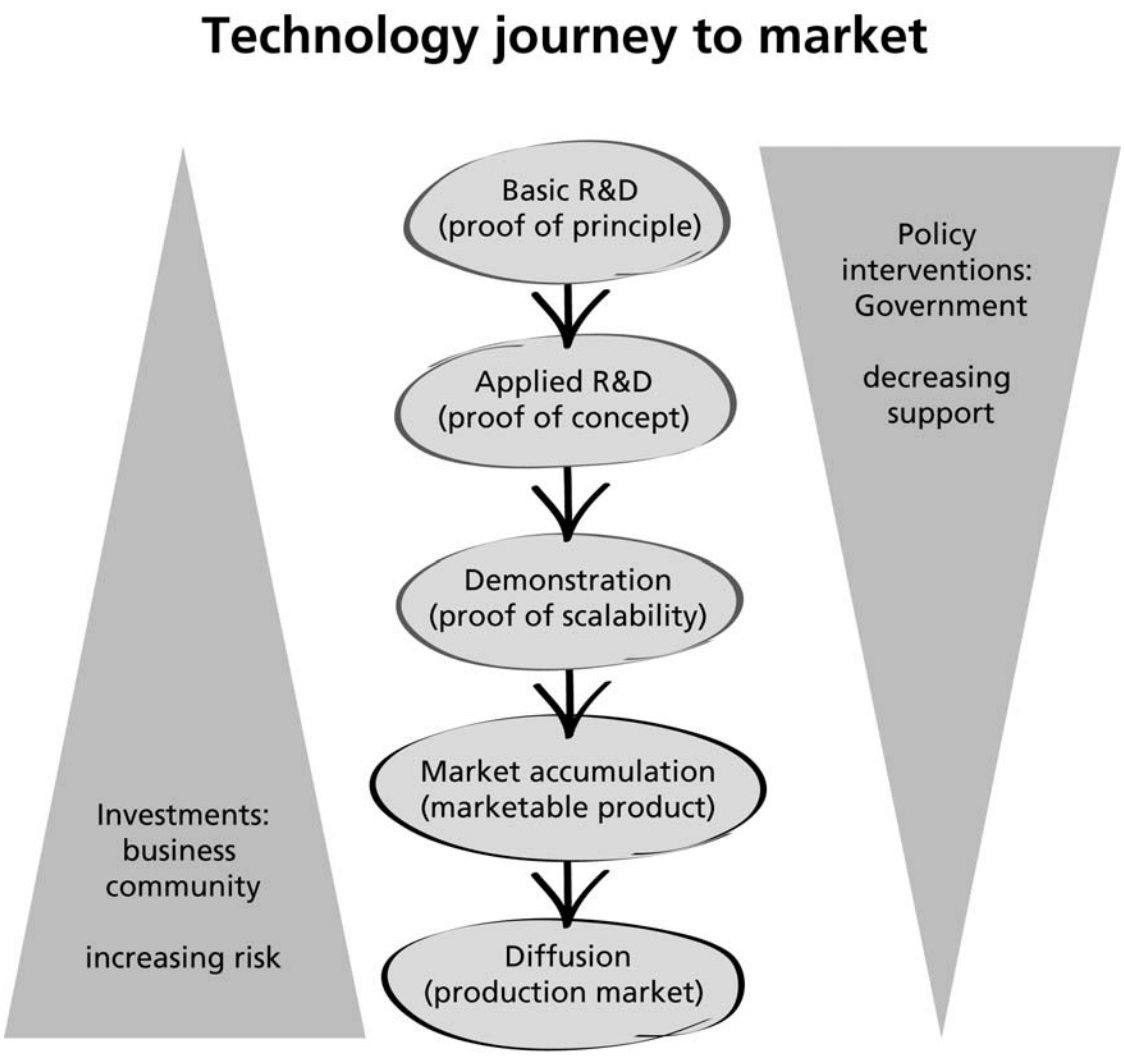


Figure 3.1. How the public and private sector can join forces in support of innovation

Source: Foxon T., Pearson P., Makuch Z., and Macarena M., (2004), "Informing policy processes that promote sustainable innovation: an analytical framework and empirical methodology". ESRC Working paper series No. 2004/4.

Table 3.1. Different categories and forms of industry-science relations

Publications	Scientific publications, co-publications. Consulting of publications.
Participation in conference professional networks & boards	Participation in conferences and fairs. Exchange in professional organizations. Participation in boards of knowledge institutions and governmental organizations.
Mobility of people	Graduates. Mobility from public knowledge institutes to industry. Mobility from industry to public knowledge institutes. Trainees. Double appointments. Temporarily exchange of personnel.
Other informal contacts/ networks	Networks based on friendship Alumni societies. Other boards.
Cooperation in R&D	Joint R&D projects. Presentation of research. Supervision of a trainee or Ph.D. student. Financing of Ph.D. research. Sponsoring of research.
Sharing of facilities	Shared laboratories. Common use of machines, location or building (science parks). Purchase of prototypes.
Cooperation in education	Contract education or training. Retraining of employees. Working students Influencing curriculum of university programmes. Providing scholarships. Sponsoring of education.
Contract research and advisory roles	Contract-based research and consultancy.
Intellectual Property Rights (IPR)	Patent texts. Co-patenting Licenses of university-held patents. Copyright and other forms of intellectual property.
Spin-offs and entrepreneurship	Spin-offs Start-up Incubators at universities. Stimulating entrepreneurship.

Source: Brennenraedts, Reginald, Bekkers Rudi and Verspagen, Bart (2004), "The different channels of university-industry knowledge transfer", *Eindhoven Centre for Innovation Studies Working Paper*, 06.04.

For research organizations, relations with industry can be a source of financial revenues but these linkages may also reinforce or complement their technical expertise in some areas, giving access to the in-house R&D facilities of companies. Collaboration is not always easy; the tension between research and commercial rationales can emerge. Conflicts of interests need to be appropriately managed and the disparity of the time horizons of partners reconciled.

B. Supporting industry-science linkages at different stages of the innovation process

From research to the market

Two types of research can be distinguished:

- Basic research. It focuses on gaining a fundamental understanding of any subject. Many times this is done with no specific application in mind, despite the existence of a broad intention to address some relevant needs for society.

- Applied research. It tends to be focused on specific needs, with a particular focus on commercial potential.

A decentralized research structure has a number of advantages:

- It avoids the disconnect between students and the research base that may emerge in a centralized system. This separation is harmful to innovation, since students are eventually a source of entrepreneurship.

- It facilitates a competitive environment for funding research, which can result in a more efficient system for R&D. Instead of restricting investment in research to specific universities, the allocation of resources can be open to wider competition.

The process of knowledge transfer from universities to businesses

Successful knowledge transfer between higher education and business requires the presence of a number of preconditions. Information regarding these elements needs to be established as part of a feasibility study, if it does not exist already. This would allow a correct diagnosis of the problems and the means to address them.

The factors to consider include:

- The involvement of higher education organizations that have a strong research capability in niche areas of significant commercial opportunity.

- Subjects of higher education research which complement and overlap the regional business base or clusters in order to speed and enhance the relevance of knowledge transfer.

- If appropriate, support for this process from physical property developments such as pre and full incubators, innovation centres or science parks. All of these are able to create a physical platform for supporting lasting knowledge transfer relationships.

- The existence of appropriate brokerage arrangements to link specific business needs with relevant academic expertise.

- Having a willing public sector partner with funding to resolve issues where there is either clear evidence of market failures or non-productive R&D results which need to find their way into the commercial domain.

- The engagement by the public sector needs to be flexible. This means that contributions must adapt to address changing circumstances and emerging threats, for example, slowdown of economic growth, new competitors or opportunities.

The role of the institutional setting

Overall, there is a wide cross-country diversity of institutional settings in public science, reflecting:

- The history of institutional development;
- The different missions assigned to public science within the national innovation system; and
- The specific priorities of science and technology policies.

Despite this diversity, some good practices in the institutional setting in public science can be identified regarding success factors in industry-science relations (see Table 3.2.).

In essence, these good practices emphasize:

- The importance of decentralization;
- The crucial role of incentives; and
- The value of mixed (public-private) systems of financing.

Table 3.2. Industry-science relations (ISR) and the institutional setting in public science

General Assessment / Critical Success Factors	Observations / Examples of Good Practice
Institutional structures and settings vary considerably between and within countries.	A decentralized model of technology transfer (responsibilities for TT activities are located at the level of research groups). However, central support (adequate administrative, managerial and financial support) should be provided.
Proper incentive systems are very important.	ISR as part of institutional mission; considering ISR as evaluation criteria; individual remuneration of ISR activities.
Fostering ISR has to be compatible with the main mission of HEIs (basic research and education).	Avoiding crowding out of basic research and education as a result of strengthening ISR.
Adequate balance between applied and basic research should be achieved	A too strong focus on applied research may undermine the long-term potential; industry sponsored R&D should not exceed approximately 50% of total R&D budget; ensuring significant publicly financed strategic R&D activities.

Source: Benchmarking Industry-Science Relations. The role of framework conditions, Final Report of the Research Project, 2001, Coordinated by the Institute of Technology and Regional Policy, Joanneum Research.

Addressing intellectual property issues

An important component of national strategies on innovation concerns how to deal with intellectual property (IP) that results from government funded research programmes. This domain of public policy has two important dimensions:

- Operationalizing policy objectives with regard to IP; and
- Facilitating the technology transfer process.

Policy initiatives regarding IP in science need to be mindful of the broader social objectives regarding the dissemination of knowledge, as distinct from the maximization of licensing revenues by public research institutions (Box C3.2.).

Box C3.2. Facilitating industry-science relations through intellectual property initiatives[18]

United Kingdom

As part of a web-based toolkit, the British authorities introduced in 2005 a set of model agreements to help business-university collaborative working and speed up negotiations for intellectual property (IP). The toolkit aims to take the hassle out of negotiating collaborative research agreements. It particularly focuses on financial contribution, the use and exploitation of IP, academic publication and confidentiality. The toolkit includes:

- Draft text for five different types of business-university agreement;
- A decision tree to help the user identify which agreement to use;
- Clear guidance notes on each part of the agreement; and
- A list of all the issues covered in the agreement.

Ireland

A National Code of Practice for Managing and Commercialising Intellectual Property from Public-Private Collaborative Research was issued in 2005, under the auspices of the Advisory Council for Science, Technology and Innovation and Forfás. The Code aims to achieve a higher degree of national cohesion on this topic, resulting in significant benefits for stakeholders and encouraging greater investment. The Code provides a set of principles and a consistent starting point for negotiation in establishing collaborative research agreements, including a flexible approach to the issues of ownership and rights of exploitation of research outcomes. An important purpose of the Code is to enable all prospective partners to approach new collaborations with a common understanding of the IP issues involved. It is intended that using this as a starting point for negotiation will help speed up negotiation times and conclude more agreements.

The technology transfer process (Box C3.3.) crucially depends on the skills of the professionals engaged in it. Therefore, technology transfer professionals should be appropriately trained. Public initiatives can provide support to professional associations to encourage professional training to their members. An example is the funding granted to the Association of University Industrial Liaison Officers in the UK.

[18] *Source*: www.innovation.gov.uk/lambertagreements; www.sciencecouncil.ie.

Box C3.3. Supporting Technology Transfer[19]

Poland
The Technology Transfer Centre (TTC) of the University of Krakow is a place of contact between the scientific and business communities. TTC promotes innovation, and implements international projects aimed at the development of science and the enhanced competitiveness of Polish enterprises. TTC has already been in operation in southern Poland for 10 years, facilitating contact between technology-related enterprises and research institutions, establishing partnerships, and providing advice to organizations that have applied for financing from EU Framework Programmes and Structural Funds. The TTC acts as an advisory centre for SMEs, provides training and assists in the preparation of grant applications. In addition, it encourages academic entrepreneurship, helping students and academics to establish their own businesses and manage enterprises in their initial phase, including through financial support.

Romania
The West Regional Development Agency, together with four universities and other regional research and development institutions created in 2006 the Tehimpuls Regional Centre for Promoting Innovation and Technology Transfer. Tehimpuls aims to stimulate the regional economy and to increase the competitiveness of enterprises in the West Region by structuring a local market for R&D and encouraging innovation through brokerage services. The centre provides assistance for developing innovative services and commercializing the results, and for encouraging collaboration between enterprises and R&D institutes, increasing awareness on innovation and technological transfer in the region.

Collaborative research

Collaborative research is one of the forms of relationships between industry and science, which is consistent with the principle of open innovation. A set of guidelines on collaborative research (Responsible Partnership), defining a voluntary code of conduct, has been elaborated by European associations representing industry, research and technology organizations, Universities and knowledge transfer organizations. A summary of these principles can be found in Table 3.3.

[19] *Source*: Contribution by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies (Poland, Romania).

Table 3.3. Responsible Partnership Guidelines for Collaborative Research

Foster strong institutions	Strong, well-connected public institutions are essential to ensure continued, privileged access to world-class knowledge and skills.
Align interests	Effective knowledge and skills transfer depends upon being able to align the partners' interests.
Treat collaboration strategically	It is important to make a strategic decision (at the highest level of the organization) about the part that collaborative R&D will play in meeting the PRO's or company's objectives.
Organize for lasting relationships	The commitment to sustain and fund effective collaborative programmes depends on a general sense of trust and understanding that results will match expectations.
Provide the right professional skills	Effective management of collaborative R&D and knowledge transfer requires high quality professional supporting skills.
Establish clear intent	When planning collaboration, the first priority is for the partners to explore and agree what they expect to accomplish.
Use standard practices and communicate regularly	Adopting standard practices encourages the development of effective frameworks for long-term collaboration.
Achieve effective Intellectual Property	Effective management of Intellectual Property (IP) is central to the knowledge transfer process, particularly since the emergence of new types of knowledge-based industry is straining the IP system.
Provide relevant training	Effective knowledge transfer requires competencies and skills in many fields beyond knowledge and IP management.
View innovation as a trans-disciplinary activity	Innovation is not simply technological advance. Choosing the best business model or social structure is sometimes more important than being the first to discover or invent.

Note: Partners of the initiative include the European Industrial Management Research Association, the European Association of Research and Technology Organisations, the European University Association and ProTon Europe.

Source: www.responsible-partnering.org

Funding and fee-based research

Large companies have usually the resources to carry out R&D but they tend to be risk adverse and limit themselves to incremental technologies. There are considerable differences across types and classes of companies in their approach towards external R&D providers, such as universities and R&D organizations. A critical issue is the fee structure to be applied in this relation. There is a need to balance:

- What the private sector is prepared to pay for high quality outsourced R&D; and

- What can reasonably be supported through funding applications by research institutions.

Curriculum development

Developing a closer link between education and the needs of the economy requires adapting the educational offer (both in terms of specialization and content), to the changing demands of the labour market (Box C3.4.). Actions that can be taken in this area include:

- Harmonization of various vocational education systems (for example, through a National Qualifications Framework based on the outcomes of the learning process);
- Development of the educational and career advisory system;
- Active participation of employers in the development and implementation of educational plans;
- Increased competence in technical disciplines, such as mathematics and natural sciences;
- Developing management and commercialization skills of R&D staff; and
- Awareness initiatives in the industry that develop links with academia.

Box C3.4. Human capital development and innovation

Denmark
The Globalisation Strategy "Progress, Innovation and Cohesion", presented in March 2006, introduced a number of reforms to enhance the innovative potential of research. The number of PhD scholarships and so-called 'industry PhDs' is to be doubled, especially within areas like natural science, technical development, ICT and health studies. Basic funding of universities is to be distributed according to the quality of research. Universities will compete annually for large, long-term research projects. Quality is to be evaluated by international, independent, expert panels. Universities are to be given more flexibility as regards recruitment of researchers.

Poland
The Priority IV of the Human Capital Operational Programme 2007-2013 ("*Tertiary education and science*"), targets the improvement of the performance of tertiary education institutions. The analysis of the condition of Polish higher education serves to identify deficiencies, develop effective tools for management and ensure high quality of education. Mobility and openness is expected from the modernization of teaching methods and curricula. The programme envisages the development of educational programmes in the field of industrial property protection, industrial design and R&D marketing. Implementation of the objectives of the Priority is also supported by university development programmes. The programmes might cover a series of issues selected by a given university (like the development of the educational offer, including e-learning, improvement of the staff, organization of traineeship and practices for students, cooperation with employers and scientific entities in the scope of implementation of the learning process and international cooperation).

The role of public-private partnerships

Public-private partnerships (PPP) in the area of research and innovation can be a useful instrument to bridge the gap between research/education and industry (Box C3.5.). PPPs can address a number of issues:

- The need to undertake multidisciplinary research;
- Funding of activities that have no immediate commercial impact; and
- Creation of linkages between various stakeholders, with implications for their respective R&D programmes.

The success of these initiatives requires:

- Anchoring joint efforts in existing technological capabilities to develop them further;
- A long-term vision; and
- Appropriate governance mechanisms are essential, both to provide leadership and to address any conflicts that may emerge.

Box C3.5. Public-Private Partnerships for Innovation[20]

France
The Networks of Research and Technological Innovation aim to prepare strategic technological projects, with the involvement of the public sector and industry. They aim to involve public and private laboratories in the joint implementation of common projects and encourage the participation of SMEs in these activities. The networks are organized along sector lines, including Audio and Multimedia, Software and Telecommunications.

The Netherlands
The Technological Partnerships Scheme provides subsidies for technological projects by corporate alliances or partnerships between companies or between companies and research institutes aimed at fundamental/industrial research or pre-competitive development. The Organization for Applied Scientific Research (TNO) seeks to translate scientific knowledge into applied knowledge that is useful for the private sector and government agencies. The contributions of the Ministry of Economic Affairs' TNO are contingent on the extent to which the private sector is prepared to support TNO research projects.

Hungary
The Péter Pázmány Programme has established Regional Knowledge Centres (RKC) to exploit research and development results in close cooperation with the industrial sector. The Programme is managed by the National Office for Research and Technology. The goal of these centres is to encourage cooperation with companies and other research organizations to manage innovative projects, focused on research and development at an international level. The programme seeks to support closer relations between public research organization and industry while stimulating regional technological and economic development.

[20] *Source*: www.telecom.gouv.fr; OECD, Public Private Partnerships for Research and Innovation: An Evaluation of the Dutch Experience, 2004; www.nkth.gov.hu.

Management structures in higher education for establishing links with the business sector

University teaching activities increase labour force qualifications. In addition, students may become entrepreneurs. Higher education institutions can make a direct contribution to business development through specific management structures:

- Science and technology parks centred in universities, that provide support to would-be student-entrepreneurs (see Chapter IV);
- Offices dedicated to building outreach programmes for linking with development agencies, business, other regional institutions and in some cases local governments; and
- Technology transfer centres.

These initiatives often receive public funding from national and regional programmes (Box C3.6.). Local programmes may include:

- Development of science parks with or without pre and full incubation (Chapter IV);
- Consultancy services which include the use of university equipment;
- Expert advice services which do not include the use of university equipment; and
- Industrial professional training programmes in which students spend up to one year in a company or organization as part of their undergraduate degree programmes.

Box C3.6. Partnering and mobility between academia and industry

United Kingdom
The Knowledge Transfer Partnerships (KTP) is a programme facilitating the establishment of collaborative partnerships between universities and business supported by government grants. KTP is one of the longest standing and most successful programmes, being open to both SMEs and larger companies. A high quality graduate is recruited to work on a specific project that the company partner has identified as central to its needs and development. During this time, they have significant training opportunities including the chance to take a Masters degree or PhD. The graduate (known as a KTP Associate) will spend the majority of their time based at the company, although legally employed by the university on a fixed term contract. Each KTP may involve one or more Associates and last between one and three years. The application procedure is quick and a grant offer is usually received within six weeks of applying. Support is provided by the host university throughout the application procedure and the duration of the project.

Portugal
The INOV Jovem Programme was launched as a way of motivating young entrepreneurs and companies to get involved in processes of training and internships. Its objective is to promote the training of young business people, to encourage the innovation processes and to nurture growth and stability in employment. The Programme seeks to find a placement for young administrators in the management and innovation areas of SMEs. It is a programme developed within the Technological Plan, which supports the integration in SMEs of young professionals up to 35 years of age, with academic qualifications in areas considered critical for innovation and entrepreneurship development.

France
Researchers are allowed to quit universities and laboratories to create a new venture based on their work since 1999. They can go back to university if desired. Between 2000 and 2005, 844 enterprises have been created by researchers in France, through academic incubators. Recently a new type of company, called "Young Academic Enterprise", allows significant advantages to encourage business creation by researchers and students.

Spain
A recent reform of the Organic Law of Universities allows University staff to leave their posts for up to five years without losing civil servant status if they are hired by technology-based firms**.**

Developing companies from university/research activities

The creation of formal structures to support spin-out companies from universities and other public research organizations (PRO) is relatively new. However, the available evidence points to some successes in this area, although these remain limited in relation to the number of companies being formed. As part of innovation and regional development policies, these activities have commonly received strong endorsement by the public sector, as part of innovation and regional development policies.

In order to create and maintain the necessary culture, infrastructure and environment for new companies to set up and thrive, the emergence and development of these spin-outs requires close interaction between:[21]

- PROs
- Local/regional governments
- Private sector.

The commercialization of research outputs through spin-out companies may give rise to tensions between teaching/research, on the one hand, and entrepreneurship/ commercialization, on the other hand. Balancing these equally important roles needs to be appropriately managed by:

- Setting a suitable system of incentives; and
- A flexible distribution of tasks and resources that is generally perceived as fair.

[21] Expert group report (2004). Management of intellectual property in publicly-funded research organizations: Towards European Guidelines, accessed at http://ec.europa.eu/research/era/pdf/iprmanagementguidelines-report.pdf.

Spin-outs or other commercialization strategies?

The creation of spin-out companies is an alternative to the licensing of the intellectual property generated by research. In comparison to licensing, spin-outs:

- Offer potentially higher rewards; and
- Required additional funding and the ability to tap into the necessary managerial expertise, which is often beyond the competencies of traditional technology transfer offices.

The choice between the creation of new companies or exploiting the technology through licensing or others forms of collaboration with the industry depends largely on the type of technology:

- Technology improvements that fit existing business models are usually better exploited by existing companies. These are in a more favourable position to develop marketable products and reach the markets.
- New business models are better served by spin-out companies, which enjoy more flexibility to explore new markets.

Table 3.4. provides a summary of the technological features that are more likely to result in the creation of a university spin-out in contrast to established firm licenses.

Table 3.4. The types of technology that lead to spin-outs or established firm licenses

Spin-out firm	Established firm
Radical	Incremental
Tacit	Codified
Early stage	Late stage
General-purpose	Specific-purpose
Significant customer value	Moderate customer value
Major technical advance	Minor technical advance
Strong IP protection	Weak IP protection

Source: Shane, Scott (2004), *Academic Entrepreneurship, Edward Elgar*, Chetelham.

Spin-outs at public research organizations

Spin-outs at PROs reflect a variety of motivations and strategies. This diversity has implications for the type of resource required and the likely dynamics of these new companies. A typology of spin-out models can be established (Table 3.5.):[22]

[22] Clarysse, Bart et alii, (2004), "Spinning out new ventures: a typology of incubation strategies from European research institutions", *Ghent University Working Paper*.

- Low selective: The PRO seeks to maximise the number of spin-outs created, which do not usually exceed a certain critical size;

- Supportive: It considers the generation of spin-outs as an alternative to licensing intellectual property, with a spin-out service embedded in the existing technology transfer unit; and

- Incubator: The alternative considered in the use of resources to generate contract research or the spinning-off of this knowledge in a separate company, depending on the estimated financial rewards.

Table 3.5. Models of spin-outs and activities of public research organizations in Europe

Activities	Selective	Supportive	Technology Incubator
Opportunity search and awareness creation	Rather passive, relies on entrepreneurial university	Passive; might organize a business plan competition; attracting business plans rather than ideas; relies on the reputation of the fund	Active opportunity seeking worldwide
Strategic choice how to commercialize R&D	Selection criteria are extremely low. Maximize the number of spin-outs	Among the selection criteria, growth orientation is important. But, remains lower than in private VCs	Selection criteria resemble those of the VCs
Intellectual property assessment and protection	Emphasis on commercializing technology through patents	Support in patent and license negotiation with the industry	TTO will acquire an IPR platform (not limited to one patent) at an early stage
Incubation and business plan development	Projects are offered space at the research center or university	Incubation center and Science park. Specialized support available out house at market prices	'In house' incubation and support at all stages of the spin-out process and to a high level
Funding process	Small amounts, ranging from €15, 000 to €100,000, in the form of public grants	Public-private equity fund, ranging from €250, 000 to €350, 000	VC money, ranging from € 1m to € 4m
Control over the spin-out process after spin-out	Project is started at a pre-founding stage. All types of spin-out are selected	Spin-off company is start up at a very early stage	Spin-off company is start-up in a late stage and with an experienced management team

Source: Clarysse, Bart (2004) et alii, op. cit.

Public support to facilitate spin-out formation

Public support (Box C3.7.) can be provided at two stages:

- Initially, in the pre-incubation phase, to identify innovative solutions and verify their market potential, providing consultancy services and developing infrastructure for new enterprises.

- Once commercial potential has been more clearly determined, more significant financial contributions can take place, including equity stakes.

Box C3.7. Supporting university and PRO spin-outs[23]

Israel
Israel's higher education institutions and university spin-outs have played an important role in the economic and social development of the country. Several government programmes and legislative acts are especially relevant for encouraging the creation of academic spin-out companies. The "Law for the Encouragement of Industrial R&D" adopted in 1985 established a programme of financial incentives under which companies (both established and start-ups) that meet certain eligibility criteria, are entitled to receive funds and grants for the development of innovative, export-targeted products. In addition, the Office of the Chief Scientist (OCS) at the Ministry of Industry and Commerce OCS administers a wide range of programmes aimed at supporting industrial R&D.

The Netherlands
The Valorisation Grant is administered by the Technology Foundation, which is funded by the Ministry of Economics. Financial support is provided for setting up new high-tech enterprises emerging for public research institutions. The grant aims to bridge the initial financing gap that arises when research funding is insufficient but there is yet not sufficient development to raise external financing. After initial support, further financing must be raised on commercial terms.

Germany
The EXIST programme, run by the Federal Ministry for Economic Affairs and Technology, seeks to improve the entrepreneurial climate in higher education and boost the number of technology and knowledge-based start-ups. It supports students and staff from higher education and research institutes who would like to translate their idea into a business plan, including the provision of funding for the seed-phase of start-ups.

Russian Federation
There are special competitions of innovative projects within and between universities like "Formula of Success", in the Moscow State University, BIT (started through several universities by Microsoft), "Russian Innovation (organized by magazine "Expert"), "Idea" (Republic of Tatarstan), and others. Winners of these events graduate to receive financial support through different federal or regional programmes like UMNIK and START. Another type of support is infrastructure around universities and research institutes – incubators, technoparks or innovation technological centres (ITC). ITCs provide not only space to start a business but also have teams to nurture the company.

[23] *Source*: documents submitted by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies.

Lessons learned and good practices in promoting spin-outs

A number of lessons and practical advice can be derived from the review of available experience:

- Spin-outs need to be grounded on the core competencies and research capabilities of research institutions.

- The ability to tap into public funding is critical to support fundamental research from which commercial applications may eventually emerge.

- Access to early-stage financing, from public funds or business angel financing, is a main constraint in the development of these companies

- Technical excellence does not necessarily imply entrepreneurial flair or managerial expertise. These are additional skills that need to be nurtured, developed or, most often, tapped into from external sources.

- Participation in external networks is essential for access to necessary complementary expertise and raise financing. These include contacts not only with the private sector, but also with other public research institutions.

- A visible presence breeds future success in attracting talent, facilitates marketing efforts and provides access to a large variety of financing pools.

National situations, goals and institutional settings differ significantly, so good practices can only be identified at a general level. The following principles can be established on the basis of the experiences of a number of European countries:[24]

- More independence, but not necessarily separation from the university, of the organization managing the formation of spin-outs. This implies the formation of separate institutions.
- Intellectual property management is a complex issue, which is strongly influenced by the national legal environment. However, conflicts between research and universities can be reduced with the early involvement of technology transfer offices.

- Public support needs to consider realistic time frames for sustainability and avoid excessive dependence on private sector funding, which may not materialise in the amounts expected and which may conflict with the desire to maximise the rate of technology transfer.

[24] University spin-outs in Europe. Overview and good practice, Brussels, 2002, accessed at http://www.cordis.lu/innovation-policy/studies/im_study4.htm.

Spin-out companies and external investors

The timing of eventual entry of external investors is an important phase in the life cycle of spin-out companies (Box C3.8.):

- Unless universities have appropriate funding, they face the risk of early dilution (i.e. surrendering a large equity stake) in order to raise resources.
- Limiting dilution implies that the burden of funding development falls to the university.
- If available resources are limited and no external financing is being sought, this can constrain the commercial potential of the companies that are being formed.

Box C3.8. The Surrey Satellite Technology Limited (United Kingdom)

In the mid-1970s, a group of highly skilled aerospace researchers were working in the Electrical Engineering Department of the University of Surrey. At the time, Space exploration was something only countries with enormous aerospace budgets could dream about. The belief was that Space was such a different environment to Earth that anything sent into the atmosphere needed to be specially designed for these harsh conditions. Naturally, this made building satellites incredibly expensive and time-intensive. Researchers at Surrey decided to experiment by creating a satellite using standard consumer technology, known as 'commercial off the shelf' (COTS) components, with positive results. That first satellite, UoSAT-1 (University of Surrey satellite) was launched in 1981 with the help of NASA, who had become very interested in the group's work. The mission was a great success, outliving its planned three-year life by more than five years. Most importantly, the team showed that relatively small and inexpensive satellites could be built rapidly to perform successful, sophisticated missions. To prove it, UoSAT-2 was built in just six months and launched in 1984. In 1985, the University formed Surrey Satellite Technology Limited (SSTL) as a spin-out company to transfer the results of its research into a commercial enterprise able to remain at the forefront of satellite innovation.
Despite the Challenger disaster of 1986 seriously damaging the world's appetite for Space exploration, within 10 years SSTL had launched eight satellites for various governments and businesses. Today SSTL employs almost 300 staff, has launched 27 spacecraft, with 14 more under manufacture. Over the last four years the company has been growing at 20% year on year. With a turnover of £40m a year it became clear that the University of Surrey could no long provide sufficient funds to allow the company to growth further, so it was sold to EADS Astrium consortium.

Innovation clubs: bringing higher education and business together

One of the enduring problems in building innovation capacity in a region is how to link SMEs with the knowledge base. Innovation clubs, which bring together SMEs and academic staff, have been formed in some countries to strengthen the relations between research institutions and business. Clubs may be formed along sectors lines (e.g. ICT, Creative Design and Data Mining, Medical Technology, Wireless Technologies, Open Source Technologies). The experience in the running of this type of institutions shows that:

- The structure of the meetings is important for their success. Round tables facilitate discussions between SMEs and academics.

- Appropriate funding is necessary to attract the attention of academics. However, these initiatives require relatively limited financing and can become a catalyst to attract external sources.

- It is critical that discussions facilitate a common understanding of the innovation club and the objectives and capabilities of participants.

- Success depends on the opening of research institutions to accepting market demands to influence their research agendas.

- SMEs remain engaged in this type of initiatives only if tangible results are delivered, which underlines the importance of good communication through qualified staff. On the other hand, appropriate profiling of SMEs is necessary to select candidates with potential among those that are high-growth business.

Innovation clubs can be the seed for the formation of fully-fledged brokerage agents that could be proactively approached to procure outsourced R&D activities. However, in the initial stages of their development, the technology pull from the education institution would be required as a catalyst of dialogue and collaboration with the private sector.

Education programmes: technology and entrepreneurship

Entrepreneurship education is increasingly seen as an important component of innovation policies, fostering the entrepreneurial mindset at all education levels, from primary school to university. These views have led to the emergence of comprehensive national strategies for entrepreneurship education in a number of countries (Box C3.9.).

Box C3.9. Enterprise education [25]

Ireland
Enterprise education has been included in the curriculum of senior cycle programmes. Students engaging in these programmes have an opportunity to consider enterprise in the wider context of personal, community, social and business enterprise. Enterprise education in these programmes is frequently explored through participation in a range of activities including a combination of classroom teaching, analysis of case studies, out of school investigations and invited visitors to the classroom. Students are also encouraged to plan, set up and run their own enterprising projects as vehicles of learning. Examples of enterprising projects include: setting up a mini company to sell a product or provide a service, a charity fund-raiser, publishing a newsletter and organizing a school

[25] *Source*: Final Proceedings of the Conference "Entrepreneurship Education in Europe: Fostering Entrepreneurial Mindsets through Education and Learning" Oslo 26-27 October 2006; Best Procedure Project "Entrepreneurship in higher education, especially in non-business studies", Final Report of the Expert Group, 2008.

event. The key elements of successful enterprise education programmes include teaching methodologies utilized, training for teachers, resources which support the teaching of enterprise education and the importance of developing links with the local community and with the business world, in addition to the active participation of business partners as mentors and advisors to students engaging in enterprise education programmes in Irish schools.

Poland
The Dynamic Entrepreneurship, Leon Kozminski Academy of Entrepreneurship and Management, is a nation-wide programme to enhance entrepreneurship education in higher education institutions, especially in non-business studies. The programme established a nationwide network platform and provided tools and mechanisms for the fast-track introduction of entrepreneurship courses. First the teaching methods, tools, cases, etc were tested at the Kozminski Academy. An accompanying textbook and a supporting webportal were introduced. The portal serves as a repository for teaching materials and a focus point for the exchange of experiences. A 'training the trainers' component was also added. With the financial support of the Ministry of Science and Higher Education, 20 entrepreneurship lecturers were trained and received ongoing methodological support in launching pilot courses. In addition to the basic course in entrepreneurship, new specialised courses have been developed, such as International Entrepreneurship and Technology Entrepreneurship for PhD students.

Good practice in education programmes

There has been an increase in the number, scope and level of higher education courses that focus on entrepreneurship in many UNECE member countries. The aims of these programmes are often to break barriers between technology and business management, facilitating communication between staff with a scientific-technical background and those with more commercial roles. Good practice education programmes incorporate the following issues:

- Have an interdisciplinary character, providing students with a range of skills across different academic disciplines.
- Curricula should include issues on technology, business management, entrepreneurship and IT.
- Emphasise practical know-how that is relevant for undertaking business ventures.
- Students should be encouraged to develop their own venture, as a exercise or, in practice, if funding is available.
- When possible, associate learning with practical experience through established links with private business or university-based commercial operations. Mentoring and coaching from people with business experience are essential elements of entrepreneurship training.
- Business plan competitions are often part of programmes aiming to foster the creation of start-ups but they are also useful in developing entrepreneurial skills and encouraging a risk-taking personality.

IV. RAISING THE EFFICIENCY OF INNOVATION SUPPORT INSTITUTIONS

Executive Summary

- *Innovation support institutions are public, private, or public-private institutions that provide support to start-up innovating entrepreneurs in commercializing their innovations and bringing them to the market.*

- *Some institutions provide public financial and/or in-kind support to start-up ventures. However, this support is of a one-off nature: at a certain point of time firms are expected to "grow up" and take care of themselves; those that fail to achieve financial viability within the established time limits will exit the market. All innovation support institutions provide business services such as coaching, consulting, managerial and administrative services, etc. to innovating entrepreneurs.*

- *Another important role of these institutions is in facilitating linkages between the potential key stakeholders of a project. They help in connectivity and networking both within the institution but also with the outside environment.*

- *A business incubator is a company or facility that provides physical space and a number of services to new businesses, helping them through the earlier stages of their development. Incubators provide access to business support, access to finance, management coaching as well as other business and administrative services to assist in the formation and growth of companies. The expected outcome is to reach a stage of developing a revenue-generating company or one that is ready to attract investment for development.*

- *There are a number of models for incubation. Full incubation offers a wide package of services that are aimed at increasing the chance of success of developing a company. The package may cover not only ordinary business services but support strategies that are tailored to developing the companies with the greatest potential.*

- *Any tenant start-up only spends a limited time in the incubator and after going through the incubation process the company should be prepared to leave the incubator and start self-sustained performance in the market. Incubators usually have their specific graduation criteria which may include the reaching of certain size and profitability but also a maximum tenure at the incubator.*

- *Science parks are property-based ventures providing R&D facilities to technology- and science-based companies. Compared to business incubators, science and technology parks tend to be much larger in size, often spanning across large territories and housing various entities from corporate, government, and university labs to big and small companies.*

- *The park may be a not-for-profit or for-profit entity owned wholly or partially by a university or a university related entity. Alternatively, the park may be owned by a non-university entity but have a contractual or other formal relationship with a university, including joint or cooperative ventures between a privately developed research park and a university.*

- *Typically, science and technology parks serve the post-incubator phase of company development or provide a launch pad for companies that are "spun out" from a university or company.*

- *Science and technology parks are important agents in industry-science linkages. Thanks to their nature, they can facilitate both the establishment of business relationships fostering the diffusion of innovation and the formation of partnership relationships with industry.*

- *An innovation cluster is a system of close links between firms and their suppliers and clients, and knowledge institutions, resulting in the generation of innovation. The cluster includes companies that both cooperate and compete among themselves. The links between firms are both vertical, through buying and selling chains, and horizontal, through having complementary products and services, and use similar specialized inputs, technologies or institutions, and other linkages.*

- *Most of the linkages that shape a cluster involve social relationships or networks that produce benefits for the firms involved. Clusters become even more visible and attractive if they have strong linkages with related clusters in other regions and countries.*

- *Clusters are based on relationships among firms. The relationships can be built on common or complementary products, production processes, core technologies, natural resource requirements, skill requirements, and/or distribution channels.*

- *Cluster initiatives are organized efforts to increase the growth and competitiveness of clusters within a region, involving cluster firms, the government and/or the research community.*

A. Innovation support institutions and firms' innovation activities

The role of innovation support institutions

- Innovation support institutions are public, or private, or public-private institutions that provide support to start-up innovating entrepreneurs in commercializing their innovation and bringing it to the market.

- Some institutions provide public financial and/or in-kind support to start-up ventures. However, this support is of one-off nature: at a certain point of time firms are expected to "grow up" and take care of themselves; those that fail to achieve financial viability within the established time limits will exit the market.

- All innovation support institutions provide (commercial or free) business services (such as couching, consulting, managerial or administrative services) to innovating entrepreneurs.

- Another important role of these institutions is in facilitating linkages between the potential key stakeholders of a project. They help in connectivity and networking both within the institution but also with the outside environment.

The system of innovation support institutions is very broad and may include various bodies (see also Box 4.1.):[26]

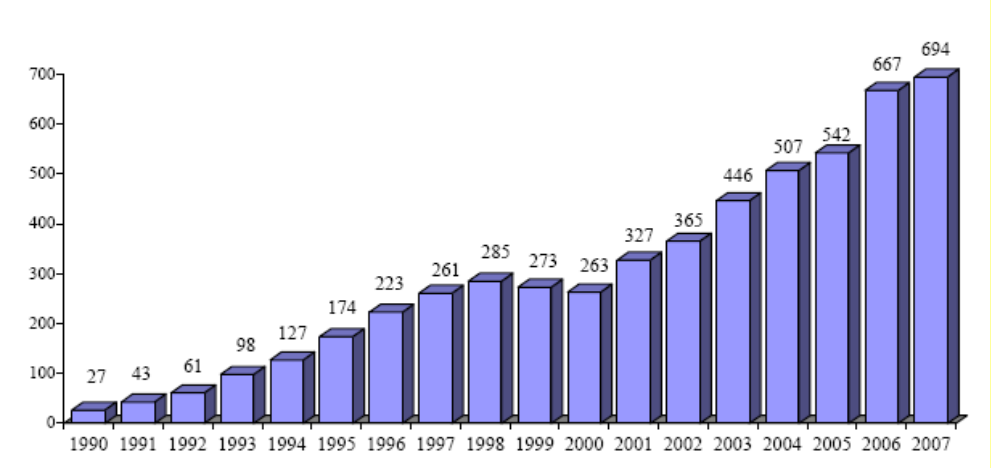
- Awareness raising and public information institutions;
- Information brokerage institutions (technology forums, fairs, networking institutions, etc.);
- Management training and consulting centres, including centres for entrepreneurship
- Innovation intermediaries (technology transfer offices, information centres at universities, etc.);
- Couching centres and consulting offices;
- Business incubators and pre-incubators;
- Science parks and technological parks; and
- Innovation clusters.

[26] Innovation support institutions also include different public and private funding agencies providing early stage financing to innovative firms. For policy options regarding these institutions see ECE/CECI/7.

Box C4.1. Innovation support institutions in Poland

The institutional infrastructure supporting innovation in Poland includes universities, the Polish Academy of Sciences, other research and development units, supporting public bodies such as the Polish Agency for Enterprise Development, the Industry Development Agency, the FIRE Innovation Centre, and a network of innovation support institutions. The number of such institutions has been growing steadily in recent years (see Chart below)

Chart. Number of innovation support centres in Poland, 1990-2007



In mid-2007, there were 694 innovation support centres in Poland:

- 326 training and consulting centres
- 87 technology-transfer and information centres
- 49 pre-incubators
- 84 local and regional guarantee funds
- 64 credit funds
- 6 seed capital funds
- 47 entrepreneurship incubators
- 16 technology incubators
- 15 technology parks
- 13 cluster initiatives.

This chapter provides some policy options for raising the efficiency of some of these innovation support institutions, namely those that are in the later chain aimed at supporting the bringing of innovations to the market. Three main types of innovation support institutions are discussed below: business incubators, science and technology parks and innovation clusters. While these institutions have many things in common, there are also distinct differences among them (Table 4.1). In reality, however, institutions often incorporate mixed features (e.g. incubators can have features of science or technology parks and vice versa).

Table 4.1. Types of innovation support institutions

Type of institution	Main features
Business incubators	• A focus on growth-oriented start-up firms • A process to help firms establish and grow successfully • Providing a range of services including communications, office equipment and a business development programme tailored to the needs of the market • Often involving common buildings, at least as a hub for broader activities • Varied models suited to local conditions, ranging from highly intensive services for a small number of firms to less intensive services for a larger number of firms
Science and technology parks	• Linked with educational or research institutions • Provides infrastructure and support services for businesses, particularly real estate and office space • Performs a technology transfer function • Accommodates also large and established businesses • Sometimes involves business incubation of new companies • May focus upon a particular industry, or be more general in nature
Innovation clusters	• Geographic concentration – spatial proximity of businesses • Specialization around a core activity to which all actors relate • Multiple actors, including firms, public authorities, academia, members of the financial sector and collaborative institutions • Competition and cooperation between the actors • Critical mass to achieve the necessary inner dynamics • The cluster life cycle with a long term perspective • Innovation, with firms in the cluster involved in technological, commercial or organizational change

Source: *Incubator Toolkit*, iDISC - the infoDev Incubator Support Center (http://www.idisc.net/en/ToolkitPrint.aspx).

B. Business incubators

A modern business incubator is a combination of physical space and facilities, entrepreneurial ideas, and administrative and management support, all joined to nurture new companies in the critical early stages of development[27] (see also Box K4.1.). The original reason for creating incubators was to replace employment lost due to industrial restructuring by assisting the emergence of new businesses. With time, they have evolved into institutions mostly oriented towards supporting innovative start-up businesses.

It is estimated that at present there are more than 5,000 business incubators worldwide of which some 1,500 are in North America, and more than 1,000 are in Europe.[28] Box C4.2. provides an overview of the experiences of several European countries in the development of business incubators. It should be kept in mind that there are definitional differences across countries and sometimes the distinctions between incubators and science or technology parks are blurred.

Box K4.1. What is a business incubator?

A business incubator is a company or facility that provides physical space and a number of services to new businesses, helping them through the earlier stages of their development. Incubators provide access to business support and services (legal, secretarial, advisory), access to finance and to other experts to assist in the formation and growth of companies. The incubation process may also include coaching, mentoring, assistance with financing issues and market analysis as well as networking and contacts with industry experts and other entrepreneurs through the incubation period. The expected outcome is to reach a stage of developing a revenue generating company or one that is ready to attract investment for development.

Main characteristics of business incubators in Europe

A survey conducted in 2006 in 25 EU countries[29] identified the following main characteristics of European business incubators:

- Size: number of full time employees. The average number of employees in an incubator is six and the median size is four. Half of the existing business incubators are run by small staff of one to three employees and 90% of the incubators employ less than 10 people.

[27] Kmetz, John L. (2000), "Business incubators for Central and Eastern Europe" (mimeo, available at www.buec.udel.edu/kmetzj).

[28] Estimates of the National Business Incubation Association of the United States.

[29] Most of the numerical examples quoted here draw from the study Goddard, J. G. and Chouk, H. (2006), "First findings from the Survey of European Business Incubators" (mimeo, available at http://www.europlace-finance.com/files/_financed_paper_1313.pdf). A smaller part of the statistics is taken from: *Benchmarking of Business Incubators*. Report prepared by the Centre for Strategy & Evaluation Services (CSES) for the European Commission's Enterprise DG, 2002.

- Size: number of tenant start-up firms currently in the incubator. The average number of tenant start-up firms in an incubator is 25 and the median size is 18. A large majority of incubators support less than 30 tenant firms.

- Sponsorship and organization. There are no strict rules and established practices and a variety of business incubation models exist in Europe. With respect to sponsorship, 48% of the existing incubators are publicly sponsored; 12% are privately sponsored and 38% have mixed sponsorship. 70% of business incubators are non-profit institutions while 30% work for profit.[30]

- Physical space. Locational proximity is a key ingredient of the incubation process and this is reflected in actual practices. The overwhelming share of incubator tenant firms (76%) are located in facilities that are managed by the incubator. The remaining tenant firms are located off-site in rented space or industrial or science parks. The estimated minimum incubator space for efficient operation is around 3,000m².

- Entry and exit. Most incubators (73%) apply standardized entry criteria and procedures. As to exit, only 43% of incubators use such criteria. It is generally considered that tenant firms should not need more than four years in the incubators to graduate (some firms graduate earlier). The survival rate of firms reared in an incubator environment is estimated at some 80-90%, which is significantly higher than the average survival rate for start-up firms operating in an open market environment.

- Delivery of business services. Business support and services are the key incubator functions. Accordingly, 70% of the incubators directly offer all or most of the added-value services. Apart from this, 50% of incubators hire external business service providers. In addition to business services proper, many business incubators assist tenant firms in their efforts to raise early stage external finance.

- Public sources of support for tenant firms. Apart from public support to the incubator itself, its tenant may also have access to public sources of support. According to the survey, the main sources of such support are (as percentage of respondents): national programmes for SMEs (64% of respondents have access to such support); regional development agencies (59%); national programmes for innovative firms (58%); local authorities (45%), tax credits (26%), etc.

[30] The situation in the United States is slightly different. It is estimated that 52% of North American business incubators are sponsored by government bodies; 20% are sponsored by academic institutions and the remaining 12% are sponsored by private entities and 16% have mixed sponsorship. Estimates of the National Business Incubation Association of the United States.

Box C4.2. Business incubators in selected UNECE countries [31]

United Kingdom
There are currently some 300 business incubators in the United Kingdom supporting some 20,000 businesses. These centres range from simple arrangements where companies can rent a desk to more sophisticated centres that provide laboratory space to support science-based developments. There are also incubators that are integrated with larger science parks in university campuses and are associated with corporate research facilities (such as Adastral Park associated with the telecoms company BT's research facility).

Business incubators play an important role in supporting a local and regional business base. Forty per cent of the 50-plus businesses on the Surrey Research Park started their development in the Surrey Technology Centre, which is a business incubator. The consensus among organizations that support this process, such as the UK Science Park Association and UK Business Incubators, is that they are successful in creating a vibrant small business sector which is an important part of the national innovation system. Thus successful incubation and subsequent support of their growth facilitates the emergence of new technology firms.

France
Some 150 to 175 organizations in France undertake business incubation activities of one form or another. Of these, however, only around 50 meet the 'minimum standard' definition set out in the French definition of a business incubator, which stipulates that an incubator must have a physical entity of its own; otherwise it is regarded as another type of business support organization. The French 'minimum standard' was devised by ELAN, the French national association of business incubators comprised of incubator managers. The standard was developed as a point of reference for business incubators based on the principle that incubators should strive to attain certain minimum benchmarks based on the provision of a predefined range of basic services.

The responsibility for incubation policy and implementation in France falls under the Ministry of Trade and Industry. The added-value of incubation is perceived as deriving from the provision of localised management advisory services on-site, and the inter-firm networking opportunities which arise from being located in an incubator environment. Outreach projects and follow-up of graduates is very much a part of the post-incubation process – however, the essence of what the incubator is and what it can achieve stems from the building itself, through which it provides a range of services and organizes a variety of activities.

Israel
The technological incubators programme was set up in 1991 with the aim of providing a sheltered environment in which scientists who have potentially marketable new inventions can nurture their innovative ideas, while receiving financial support, expert business advice, subsidized office resources and exposure to interested investors. Some of the technological incubators are strategically located near the country's universities, where researchers work hand in hand with entrepreneurs.

[31] *Source:* Documents submitted by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies and other members of the UNECE expert networks; *Benchmarking of Business Incubators*. Report prepared by the Centre for Strategy & Evaluation Services (CSES) for the European Commission's Enterprise DG, 2002.

Most of the universities in Israel have developed or are partners in technological incubators. The universities have highly active representatives on the boards of the incubators and are involved in their operations. Even incubators who do not have academic institutions as part owners maintain close links with universities and research institutes, since most development projects either have or are in the process of building up networks and cooperation together with the universities.

Each incubator receives 718,300-1,235,300 NIS annually (135,000-235,000 Euros) from the State to cover the costs of premises and administration (85% of this two-year budget is a grant). The innovators are mainly academics, usually with a background in research. The incubators have complete freedom to choose different product and marketing directions, as there are no central directives. Many incubators themselves have chosen to follow a particular direction, especially those who are working close to a university or research institute. One of the criteria for a product idea to be accepted by an incubator is that it should not only be commercially viable, but a product which can be made in Israel and exported.

Denmark
There are eight business incubators in Denmark, all of which are located inside Science Parks. Incubation in Denmark is focused on supporting and developing high-tech orientated SMEs. The responsibility incubator policy is with the Department for Business Promotion (EFS), which is part of the Danish Ministry of Trade and Industry. The policy vis-à-vis business incubators has changed over time. Initially, the primary objective was to provide a supportive and conducive environment for SME start-ups by investing in incubators as an integral part of the business infrastructure, supported and underpinned by the public sector, in order to compensate for market failure in the Venture Capital markets. Now, however, EFS views its incubation activities not as an extension of the business support infrastructure, but rather as an early stage venture capitalist. Incubators are viewed as playing an important role in providing support in the very early stages of new business development where VCs remain less forthcoming. EFS considers its role today to be that of pump priming, of developing the early stage company market to achieve sufficient critical mass that the private sector will enter the market and provide an exit mechanism. Most incubators in Denmark are run along more commercial lines: breakeven, not previously an objective, is now a stated objective of EFS and its network of publicly funded incubators.

The business incubator stakeholders:

According to various surveys, the group of key stakeholders usually includes (some of) the following bodies:

- Government agencies;
- Local authorities;
- Universities and R&D institutes;
- Business associations;
- Corporations;
- Institutional and private investors ;
- Banks and other financial institutions; and
- NGOs.

The incubator business model [32]

The main function of business incubators is to provide services and support to incumbent start-up firms thereby preparing them for self-sustained performance. Accordingly, incubators have their own business model defined by their main support and service functions:

- Strategic counselling focuses on incubator involvement in binding and strategic guidance of the stock of emerging enterprises.

- Financing measures the amount of venture capital available and the extent of networks and strategic cooperation in raising the necessary funds to support affiliated companies.

- Monitoring covers the extent to which incubators monitor technical and financial development, and the ability to impose sanctions if certain goals are not met.

- Outreach measures to which extent the incubator is actively involved in scanning and evaluating potential business ideas that fit the overall goals of the incubator.

- Cooperation with knowledge institutions measures the extent of collaboration between incubator and knowledge institutions as well as the extent of cooperation with institutions that are focused on the area of specialization.

- Networks cover the scope of external participants that offer guidance for attached companies.

- Degree of specialization measures to what extent incubators offer specialization within specific technologies.

The business incubator manager

The manager of a business incubator is the key resource person at that institution and the success of the incubator crucially depends on his or her managerial knowledge, experience, abilities and skills. A colourful portrait of the incubator manager is that of a person who is:[33]

- The CEO
- The landlord
- The rent collector
- The arbitration
- The professional business consultant
- The social worker

[32] *Benchmarking Incubators*. Background Report for the Entrepreneurship Index, National Agency for Enterprise and Construction (Denmark), December 2004.

[33] Drawing on a humorous definition coined at Durham Business School, Durham University, UK.

- The ambassador of all
- The friendly, ever-available counsellor
- The policemen
- The health and safety officer
- The project manager
- A business trainer
- The housekeeper
- The tough buyer
- The persuasive sales representative
- The font of all knowledge
- The free legal advisor
- The computer expert
- and many more.

The role of the incubator supervisory board

The supervisory board of the incubator represents the interests of its main sponsors and key stakeholders. It is tasked with the following main functions:

- Strategic planning (vision, mission, values, strategic objectives);
- Formulating the policies of the incubator;
- Definition of criteria and parameters for selection of tenant start-ups;
- Evaluating performance; and
- Managerial supervision.

Main steps in business incubator formation [34]

- Specification of incubator goals. These should be coordinated with the objectives of the community and the sponsor.
- Establishment of a local working group to take responsibility for initial work in incubator formation.
- Assessment of local business support, in terms of training, experience, and technical expertise.
- Analysis of local economic activity, including both entrepreneurial activity and market potential.
- Site identification.
- Identification of financing sources for both the facility and its tenants.
- Creation of start-up plan.
- Marketing and publicizing of the incubator.
- Evaluation and redefinition of goals.

[34] Based on Kmetz, John L., op.cit.

Selection of start-up tenants[35]

The function of the selection process is choosing, from amongst candidate companies, those with the greatest potential for success. The selection process has three critical parts:

- Each incubator has its own selection criteria that stem from its mission and strategic objectives, the specific focus of the incubator and the characteristics of the start-up company (feasibility, degree of innovation, team capacity, expected impact).

- The selection process usually involves several stages, including preliminary evaluation, elaboration of a business plan, interviews, presentation at an evaluation committee.

- The selection process involves a number of professionals, including technical experts, business people, financiers, representatives of the incubators' stakeholders and managers.

- In some cases, especially when the business incubator is part of a science and technology park, the selection process passes through a so-called 'pre-incubation' which is a specific mechanism for breeding potential entrepreneurs (see Box K4.2.).

Box K4.2. Pre-incubation

A pre-incubator is a facility that sits at the interface between a university and a full incubators service or a science and technology park. The pre-incubator is essentially a model for helping to develop business and marketing acumen in parallel with technology/product/service development. The pre-incubator services include a programme for coaching and development, the aim of which is a well-designed and well structured business plan completed by the company establisher.[36]

Pre-incubators offer a range of services, such as:

- Consulting and coaching to the establisher of a company.
- Services to develop innovation and business ideas that emerged in university.
- Services related to valuation and development of ideas necessary in business activity, technology and branch skills.
- Providing legal cover for commercial activities prior to the establishment of a start-up.

Under such a pre-incubation model, potential entrepreneurs (such as students or academics) are

[35] Adapted from *Incubator Toolkit*, iDISC - the infoDev Incubator Support Center (a virtual networking and knowledge-sharing platform for incubators and technology parks), available at ttp://www.idisc.net/en/ToolkitPrint.aspx.

[36] See USINE Project, "The Pre-incubation Approach", mimeo (available at http://www.usine.uni-bonn.de/Downloads/bilder/preincubation.pdf) and Sheen, Margaret and Broadfoot, Charles (2002), "A Guide to Pre-incubator Best Practice", mimeo (available at http://www.usine.uni-bonn.de/Downloads/bilder/bestpractice.pdf).

able to test the marketability of a product or idea prior to the foundation of their own company or at a very early stage of development of a company. The pre-incubator also provides a good training environment for potential entrepreneurs or entrepreneurial teams by putting them in an active position with respect to the commercialization process of their R&D results. In addition, the pre-incubator may offer special support, such as entrepreneurial courses, personal mentoring and access to relevant networks, as well as a range of other benefits such as negotiating skills, insurance. Depending on the business model, the pre-incubator may also cover some additional expenses, e.g. for market analysis, marketing, external legal or economic consultancy, business letters, business cards, PR, novelty research, fees for filing a patent or brand, office supplies, software, expenses for telephone and fax, travel expenses, the rent for offices in the technology centre.

Value adding by business incubators

The most successful business incubators not only provide services to their tenant start-ups but also add value, i.e. contribute to increasing of the market value of these businesses.

- Value adding is costly as it implies active governance: monitoring company behaviour and performance, providing strategic advice and networking opportunities; involvement in management recruitment, etc.

- Value adding spills over in formal participation in Board meetings and often involves day-to-day communication.

- Value adding is also a learning process for incubator managers: managers more often learn by doing; skills can also be acquired through training.

- Value adding is also a relationship: often success hinges on the chemistry of this relationship.

Graduation[37]

Any tenant start-up only spends a limited time in the incubator and after going through the incubation process the company should be prepared to leave the incubator and start self-sustained performance in the market.

- Incubators usually have their specific graduation criteria, which may include reaching a certain size and profitability, also a maximum tenure at the incubator.

- Graduation policy should be open and transparent and tenant start-ups should be fully aware of it.

- Ideally, the timing of exit should be agreed upon between the incubator management and the tenant well in advance.

[37] Adapted from *Incubator Toolkit*, op.cit.

- Graduation policy may also include criteria for exit by unviable companies.

Financial sustainability

The business incubator's long-term performance hinges on its financial sustainability, i.e. on its capacity to meet its own expenses with sufficient revenues. The possible models of achieving financial sustainability depend on the incubator's business model.

- Financial independence means that the incubator generates from its own activities and services enough income to pay for its operational expenses. This is a preferred option as it can insulate an incubator from all uncertainties.

- There may be models of financial sustainability, which do not necessarily imply full financial independence. In any case, sustainability implies that the operational expenses are matched by income generates from the incubator's own activities and a continuing stream of subsidies from its sponsors.

Incubator Performance Evaluation[38]

Periodic evaluation serves to provide qualitative and quantitative information on incubator performance over a given period. The performance of business incubators should be judged primarily in terms of the results achieved as compared to their objectives and goals but also in terms of their impact on businesses and the economic environment. Feedback from companies is an important source of information for this evaluation. Business incubators should also benchmark themselves against best practice standards and take the steps required to achieve them.

- The key issue is the development and adoption of an incubator performance evaluation system, which collects and analyses quantitative and qualitative data.

- Within an evaluation system, it is important to develop evaluation criteria. Structured criteria can assist the incubators relations with sponsors and financing agencies.

- Evaluation criteria may be further broken down into evaluation issues – the key issues to be addressed in the process of evaluation – and performance evaluation indicators – quantitatively measurable indicators reflecting various aspects of incubator performance.

- Generally, an evaluation system includes assessment of incubator performance by the following four components: results or outputs of companies and incubators; resources

[38] Adapted from *Benchmarking of Business Incubators*. Report prepared by the Centre for Strategy & Evaluation Services (CSES) for the European Commission's Enterprise DG, 2002 and *Incubator Toolkit*, op.cit.

used by the incubators - financial, technological, material, human; organizational processes; and institutions most directly involved in the incubation process.

- A practical approach towards organizing the evaluation issues and performance evaluation indicators is their structuring by the inputs and processes involved ("incubation") and the outputs or results achieved.

Tables 4.2. and 4.3. illustrate the structuring of performance evaluation criteria and their breakdown into evaluation issues and performance evaluation indicators.

Box K4.3. Measuring the performance of institutions and the effect of policy interventions

Measurement may seek to identify three key elements:[39]

- The appropriateness of interventions: assessing whether the policy or intervention is relevant with regard to the technical, social or economic problems it is meant to solve.
- The effectiveness of interventions: the fact that expected effects have been obtained and that objectives have been achieved. Calculated by relating an output, result or impact indicator to a quantified objective.
- The efficiency of interventions: the fact that the effects were obtained at reasonable cost. An efficiency indicator is usually obtained by dividing the budgetary inputs by the quantity of effects obtained.

Incubation policy evaluation

Apart from evaluating the performance of the incubators as innovation support institutions, it may be important to evaluate the effect of policy measures seeking to enhance their efficiency (see Box K4.3.). The possible indicators for this type of evaluation include (all indicators can be taken both in absolute terms and in proportion to the allocated public funds):

- Number of firms incubated;
- Percentage of survival of incubated firms (after three years);
- Percentage of high growth incubated firms (after five years);
- Number of incubator firms[40] operating in high technology industries;
- Employment in incubator firms operating in high technology industries;
- R&D and innovation expenditures per employed person in incubator firms;
- Number of patents/patent applications by incubator firms;
- Exports of high technology products by incubator firms;

[39] *Practical Guide to Cluster Development*, Report to the Department of Trade and Industry and the English RDAs by Ecotec Research & Consulting, 2003 (http://www.berr.gov.uk/files/file14008.pdf).

[40] "Incubator firms" include both tenant firms and firms that graduated from the incubator(s) ("incubated firms").

- Incubator firms cooperating with each other or with R&D organizations;
- Financial self-sufficiency of the incubator(s); and
- Attracted external investment to support the incubator and/or incubator firms.

Table 4.2. Performance evaluation: definition of key evaluation issues

Criteria	Inputs and Processes	Outcomes
Relevance	Incubator mission and strategy and relevance to enterprise and regional development priorities.	Extent to which incubator tenant characteristics match definition of target market and admission criteria.
Efficiency	Financial inputs, operating procedures and unit cost of providing incubator facilities and services to client companies.	Cost effectiveness of outputs (e.g. cost per successful business start-up, cost per gross/net job created).
Effectiveness	Extent to which incubator achieves key operational targets set out in business plan (e.g. survival and graduation rates).	Extent to which incubator achieves targets with regard to enterprise and wider regional development impacts (e.g. job and wealth creation).
Utility	Occupancy rates and take up of incubator support services.	Extent to which incubator services meet client needs and contribute to performance.
Sustainability	Financial sustainability of incubator (e.g. extent to which operating costs are covered by income), level of demand for incubator space and services, incubator charges compared with market rates.	Graduation rates, retention of graduates in local area, and extent to which incubator promotes new start-ups in sectors of local economy with long-term job and wealth creation potential.

Source: *Benchmarking of Business Incubators*. Report prepared by the Centre for Strategy & Evaluation Services (CSES) for the European Commission's Enterprise DG, 2002.

Table 4.3. Performance evaluation: Definition of key performance evaluation indicators

Criteria	Inputs and Processes	Outcomes
Efficiency	Start-up time – length of time required to establish incubator Incubator investment cost – total investment/ sq m of incubator space Incubator operating cost – operating costs/number of personnel Financial leverage – ratio of public to private sector funding Income generation – proportion of income from client charges	Cost of incubator units – total investment/sq meter of space Cost per start-up – total investment/number of start-ups Cost per graduate – total investment/number of graduates Cost per (gross/net) job – total investment/ jobs in tenant and recent graduate firms
Effectiveness	Occupancy rate – percentage of incubator space let to companies Incubator service utilisation rate – percentage of companies using incubator support services Response rate to client surveys – percentage of tenants responding to client satisfaction surveys	Incubator turnover – number of firms entering/leaving incubator, average time in incubator Client satisfaction – percentage of firms indicating that incubator services meet their needs, contribution of incubator to firms' development (additionality)
Utility	Start-up rate – number/percentage of admissions leading to start-ups Start-up time – length of time required to start up new businesses Survival rate – number/percentage of start-ups still trading after three years	Wealth creation – Average turnover of tenant firms and average annual growth rates, value added of business activities Job creation – number (and type) of jobs per tenant firm and annual growth rates, proportion of jobs filled by local people, job quality
Sustainability	Financial breakeven – income minus operating costs Market rates – level of discount/premium for incubator space/services compared with local market rates	Graduation rate – percentage of tenants leaving incubator each year Growth sectors – proportion of graduates in growth sectors Retention rate – percentage of graduate companies remaining in local area

Source: *Benchmarking of Business Incubators*. Report prepared by the Centre for Strategy & Evaluation Services (CSES) for the European Commission's Enterprise DG, 2002.

Summing up: how to design and run a successful business incubator?

Table 4.4. provides a checklist of the main issues that need to be addressed in the process of designing and planning a business incubator. The same checklist applies for the purposes of evaluating incubator performance.

Table 4.4. Checklist of main questions to address before starting an incubator or during its performance evaluation

Topic	Question	Issues to address
Mission	Describe the mission and focus of your incubator and its objectives	Is this a public mission or a financial objective or both? Has the incubator a focus by industry, technology, region or customer? Why have you / have you not chosen a particular focus? How are you different from other incubators?
Size and scope	What is the size of your incubator?	Number of full-time employees Number of tenant start-ups Size and duration of investment fund Is this the desired size and how you will achieve that?
Customer orientation	What are the goals you pursue for your start-ups?	What is customer success? How do you measure success? How do you evaluate progress of tenant start-ups towards success?
Customer selection	How do you select and filter applying start-ups?	Technology: Is the technology compelling? Is there a large or growing market for the technology? Is the founder team committed and capable? Do you have the capability to help the company? Will they add to a positive environment at the incubator? Selection process: What are your selection criteria and how are they related to your mission, focus and objectives? Who performs the selection? Do you have a defined or best-practice selection process? What is your selection rate and how does it compare to other incubators?
Services offered	What services and benefits are provided by the incubator?	Office space Office support such as secretarial services Coaching Access to professional services (accounting, legal, etc.) Access to venture capital or other sources of finance Access to customers, suppliers and professional networks Access to human resources Other
Quality of services	What is the quality of your services and benefits?	What services are most appreciated by your tenant start-ups? Is there a difference in appreciation of services across start-ups? How do you evaluate customer satisfaction? How do you compare to other business incubators?

Topic	Question	Issues to address
Investors	Who are your investors, how did you enlist their support and involvement?	What type of investors, if any (business angels, venture capital, institutional investors) Why have they selected your incubator to invest in? Apart from investing, are they involved in management/value adding activities?
Management	How do you manage allocation of time, money, and resources to tenant start-ups?	How do you devote your time to tenant start-ups: evenly, or focused on one start-up at a time? What are criteria for assigning more office or infrastructure to a tenant start-up: based on need, or based on expected returns? How tightly do you control spending of your tenant start-ups? What is your internal investment policy?
Graduation	What is your graduation policy?	What are the main graduation criteria: Tenure? Size? Funding? Profitability? What are your criteria to discontinue support to a customer? What is an average time of stay of a start-up in your incubator?
Cooperation	How and to what extent do you cooperate with others?	Do you see room for cooperation with other incubators? What can you gain from such cooperation? Do you see room for cooperation with other potential stakeholders (investors, law firms, consulting companies, etc.)
Future prospects	How do you see your incubator evolve in the future?	What are your long terms objectives? Do you have a strategic plan to pursue these objectives? What are the main factors that your strategy depends on? Key success factors and threats.

Source: Adapted from: Rahul Patwardan, "Best Practices for Managing Incubators", available at http://www.indiaco.com.

C. Science and technology parks

Science parks – sometimes called research parks or technology parks (technoparks, technolopes), or combinations of those – are usually property-based ventures providing R&D facilities to technology- and science-based companies. Various definitions have been proposed, often differentiating among the categories of parks or focusing on some of their specificities (Box K4.3.).

Compared to typical business incubators, science and technology parks tend to be much larger in size, often spanning large territories and housing various entities from corporate, government, and university labs to big and small companies. Science parks do not necessarily offer a full range of business support and services but some parks may host a business incubator focused on early-stage companies. Typically, however, science and technology parks serve the post-incubator phase of company development or provide a launch pad for companies that are "spun out" from a university or company.

Box K4.4. Different definitions of science parks

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

The Association of University Research Parks (AURP) based in the United States defines a university research park as "a property-based venture, which has:

- Master planned property and buildings designed primarily for private/public research and development facilities, high technology and science based companies, and support services.
- A contractual, formal or operational relationship with one or more science/research institutions of higher education.
- A role in promoting the university's research and development through industry partnerships, assisting in the growth of new ventures and promoting economic development.
- A role in aiding the transfer of technology and business skills between university and industry teams.
- A role in promoting technology-led economic development for the community or region.

The park may be a not-for-profit or for-profit entity owned wholly or partially by a university or a university related entity. Alternatively, the park may be owned by a non-university entity but have a contractual or other formal relationship with a university, including joint or cooperative ventures between a privately developed research park and a university."

The United Kingdom Science Park Association (UKSPA) defines a science park as "a business support initiative whose main aim is to encourage and support the start-up and incubation of innovative, high-growth, technology-based businesses through the provision of: infrastructure and support services including collaborative links with economic development agencies; formal and operational links with centres of excellence such as universities, higher education institutes and research establishments; management support actively engaged in the transfer of technology and business skills to small and medium-sized enterprises."

Types of science parks

Some of the nuances in the definitions of different types of parks are related to the existence of a key stakeholder defining the mission and strategic objectives of the park. From this perspective, four main types of science parks can be distinguished and, accordingly, four science park models (Table 4.5.):

- Alliance-driven
- University-driven
- Company-driven
- Cluster-driven.

Table 4.5. Four science park models: Main features

Model	Main features
Alliance-driven	• Two or more partners cooperate in driving the development and growth of the park; • A common objective of economic development based on knowledge transfer and innovation; • Public sector funding is made available for infrastructure development and initial buildings; and • The organization is created to manage and develop the science park and pursue strategic objectives.
University-driven	• The science park is physically integrated into the university campus - university owns land and science park generates income; • A significant proportion (typically > 40%) of tenant companies are spin-outs or start-ups; • A significant number of academics participate in tenant businesses as directors, mentors, partners, etc.; • Entrepreneurship is a core feature of the university curriculum; and • The university provides business incubation for its own spin-outs and spin-ins from the local economy.
Company-driven	• The anchor tenant occupies most of the science park premises; • This attracts other tenants, some of them as part of the anchor's supply chain; • 'Open Innovation' attitude exists between the anchor tenant and others; • The research focus of the associated university is strongly influenced by anchor tenant's products/services; and • The associated university gears much of its teaching to anchor tenant's requirements.
Cluster-driven	• A cluster of companies active in one sector, geographically co-located; • A partnership formed to provide services to cluster companies; • Links with knowledge creators arising through demand from companies, not academic push or government policy; • No single owner of facilities or land; and • Marketing opportunity to support economic development – science city concept.

Source: Allen, John (2007), *Third Generation Science Parks*, published by Manchester Science Park.

There are also other typologies of science and technology parks. An important classification parameter is their relation to specific policy action(s) or intervention(s). From this perspective one can distinguish between two main types of parks:

- Science and technology parks that are market-led and are a response to a clear market demand for the type of accommodation, business support services and access to technology and skills that science parks attempt to deliver.

- Policy-led science and technology parks. Usually these are developed in response to an interest by a local agent or partnership, which may include a university, the public sector and in some cases a business community that sees the need to respond to a market failure where no space is being developed that can accommodate SMEs, many of which are at a pre- or incubation phase.

The commercial risks for policy-led parks usually lie with the public sector (at national or regional level), while market-led parks are often supported by private funding.

What all science and technology parks have in common is that they are knowledge partnerships that foster innovation. Another common feature is that science and technology parks are regional formations that always build on local resources.

Main characteristics of science and technology parks

A survey conducted by the International Association of Science Parks (IASP) in 2007 among its members (including parks from all over the world) has identified the following main characteristics of science and technology parks: [41]

- Location. Science and technology parks are mostly an urban (or semi urban) phenomenon, with 66% of the surveyed parks being within a city and 27% quite close to one (25 km or less). 36% of the parks are located on a University campus or adjacent to one.

- Size: surface occupied by the park. 45% of the parks have relatively small surfaces (less than 200,000 m^2). On the other hand, 33% of the parks have more than 600,000 m^2, of which 22% occupy over 1 million square meters.

- Size: built area. 17% of science and technology parks have reported less that 15,000 m^2 of buildings, 45% - between 15,000 and 80,000 m^2, and 38% of parks – more than 80,000 m^2 of buildings.

[41] Statistics available at http://www.iasp.ws/. The numbers presented here are calculated on the basis of the IASP statistics but refer to shares among the parks that have reported the corresponding parameter (not all survey firms have reported data on all surveyed parameters).

- Size: number of resident companies. 58% of parks report having 100 resident companies or less; and 23% - more than 200 companies. Middle-size parks (those with 101 to 200 companies) represent 19% of the total number.

- Ownership. Public ownership (governments and public administrations of different levels: national, regional, local) of science and technology parks prevails: 54% of parks reported that they are owned exclusively by such public bodies. 16% of parks I are entirely private and 30% have reported mixed (public-private) ownership.

- Public support. Most science parks receive public financial support of some sort. The most widespread forms of such support are: grants (45.4% of parks); subsidies (40.3% of parks); tax incentives (27.3% of parks) and subsidized loans (20.8% of parks).

- Focus/specialization. 39% of the science and technology parks are "generalist" (parks that admit companies and activities from any technology sector); 17% of the parks are "specialist" (parks that have chosen to specialize in one sector (or in a limited number of sectors) and 43% are "semi-specialists" (parks that favour certain technology sectors over others, but will still admit companies operating in other technology sectors besides those of their preference).

- Incubation. 88% of the reporting parks have incubation facilities or programmes. 46% of the parks have one or more business incubators managed in-house, whilst 33% have incubators on their premises, albeit not depending on the park itself. 9% of parks declare that business incubation is their main activity.

A similar survey conducted by the Association of University Research Parks (AURP) among its members in North America (134 responses) provides the profile of a typical North American university research park (Table 4.6.).[42]

[42] Note that the statistics in Table 4.6 refer to university research parks only (which are mostly "University-driven parks", as per the classification in Table 4.5), whereas the IASP statistics cover all types of science and technology parks.

Table 4.6. Profile of a typical North American university research park

Size	• 114 acres • 6 buildings • 314,400 sq. ft. of space, 95% occupied • Only 30% of total estimated sq. ft. at build out currently developed • 30,000 sq. ft. of incubator space.
Location	• Suburban community • Less than 500,000 population.
Governance	• Operated by the university or university-affiliated non-profit organization.
Tenants	• 72% are for-profit companies • 14% are university facilities • 5% are governmental agencies.
Employment	• Typical park employs 750 • Major industry sectors: IT, drugs and pharmaceuticals, and scientific and engineering service provider.s
Finances	• Less than $1 million per year operating budget • Revenues primarily from park operations but funds also come from universities and state, local, and federal government • Limited or no profitability; 75% of the parks have no retained earnings or retained earnings of less than 10%.
Services	• Provide a range of business and commercialization assistance services, including: o Help in accessing state and other public programmes o Linking to or providing sources of capital o Business planning o Marketing and sales strategy advice o Technology and market assessment.

Source: *Characteristics and Trends in North American Research Parks: 21st Century Directions*, Prepared by Battelle Technology Partnership Practice in cooperation with the Association of University Research Parks, October 2007.

Science and technology parks have been adopted as a policy concept and practical tool in many countries, including countries with economies in transition. In terms of the structuring of the institutions, these countries have largely followed the models of more advanced economies. However, the experiences of some of the catching-up UNECE economies with the promotion of technology parks have been mixed. In particular, in many cases these institutions have not yet established themselves as drivers of the generation and diffusion of innovation. On the other hand, the lessons learned from the experiences of some relatively more advance countries can also be of use for the catching-up economies (see Box 4.3. on the experiences of Greece and Kazakhstan).

Box C4.3. Science and technology parks in Greece and Kazakhstan

There have been two main waves of establishing science and technology parks in Greece.[43] The first wave started at the beginning of the 1990s and included the establishment of seven organizations by public research institutes and universities. This was the result of government initiatives which encouraged universities and other public research institutes to create new firms to exploit their R&D results. It also aimed at attracting other knowledge-intensive enterprises willing to benefit from close proximity to the education and research institutions. The experience of the first wave of parks has been mixed, with parks failing to attract large number of tenants. Among the problems identified in this phase have been relative weak linkages with R&D institutes or universities, inadequate funding opportunities, inefficient management, partly related to inadequate managerial incentives. A second wave is currently underway in the framework of the national "Competitiveness" programme. It is focused on organizations (business incubators and science parks) fully owned and operated by the private sector and run for profit. They keep close to the market, provide seed capital and access to venture capital, and buy into the tenant companies. At the same time, they can still benefit from public support, as the "Competitiveness" programme envisages funding support for high technology spin-offs, incubation of innovative firms, and for innovation intermediation or liaison offices.

In 2005, there were seven technoparks operating in Kazakhstan.[44] These have emerged through the initiatives of entrepreneurs from public administration, primarily at the local level. Technoparks are relatively young and small ventures, housing between 16 and 46 small enterprises not all of which are commercially active. On average technoparks employ some 200 to over 300 people. The scope of technopark services offered and used differs widely.

Technopark firms are largely oriented towards the local market: the overwhelming share of their sales is destined for the local market and only a small part goes to the national market (none of these firms is engaged in exports). Firms in the technoparks operate mainly in traditional activities, and, except for a few pharmaceutical SMEs, do not fully match the image of technoparks as places for the commercialization of new technologies. Firms within technoparks are not more innovative than firms outside technoparks. Many firms residing in technoparks are hampered by cash flow problems and see lower rents as an important benefit. In general, technopark firms see image and outside perception of their status as a key benefit, possibly also facilitating their access to external finance. Overall, Kazakh technoparks until now operate more like business parks or/and business incubators for locally oriented firms in traditional sectors, rather than centres of innovation promotion and diversification of the economy. Their transformation into innovation drivers would benefit from the introduction of targeted support for new-technology-based firms.

***Typically, the main objectives and functions of science and technology parks are*:**

- Promote the generation and commercialization of innovative technologies and products;
- Promote knowledge sharing and networking among different innovation stakeholders;

[43] See Sofouli1, Evangelia and Vonortas, Nicholas S. (2007), "S&T Parks and Business Incubators in Middle-sized Countries: the Case of Greece", *Journal of Technology Transfer*, Vol. 32, No. 5, pp. 525-544.

[44] Based on: Radosevic, Slavo and Myrzakhmet, Marat (2006), "Between Vision and Reality: Promoting Innovation through Technoparks in Kazakhstan", UCL Centre for Slavonic and East European Studies, Economics Working Paper No. 66.

- Stimulate investment in new-technology-based firms;
- Generate new employment opportunities through the commercial application of new technology; and
- Contribute to wealth creation and rising welfare in the region through its activities.

***Science and technology parks pursue these objectives by*:** [45]

- Attracting and physically clustering together new and established technology-based companies;

- Leveraging local science and technology resources to enhance a region's economic base;

- Extensive knowledge transfer, including the transfer of ideas as well of new and established technologies and their wider dissemination;

- Providing an effective interface, often based on a shared research environment, between universities and/or research institutions and private industry;

- Facilitating the start-up and growth of locally-founded high technology firms, in particular, through in-house incubator facilities; and

- Encouraging partnerships (both collaborative research and alliances), based on strong and specific commitments, between research organizations, businesses and public bodies, to better achieve their individual and joint objectives by working closely together.

Science and technology parks are important agents in industry-science linkages

Science and technology parks constitute some of the important building blocks of industry-science linkages. Thanks to their nature they can both facilitate the establishment of business relationships fostering the diffusion of innovation and the establishment of partnership relationships with industry such as:

- Establishment of joint research laboratories;
- Opening park facilities to outside users from industry;
- Developing pilot plants or demonstration laboratories, open to industry (or joint development);
- Liaising with university technology transfer offices;
- Professional development/training for practitioners from the industry, including training based on advanced technologies; and

[45] Kirk, Chris M. and Catts, Brian C. (2004), *Science and Technology Park Scoping Study*, mimeo (available at: http://www.regdev.govt.nz/conferences/2005/workshop/pdf/chris_kirk.pdf).

- Networking for human resource matching to meet industry demand (including internship programmes and assisted job search for graduating students).

Critical factors for the success of science and technology parks[46]

Successful science and technology parks have strong and ongoing local support, commitment, and leadership. They are founded on a clear vision and realistic expectations, and are developed as long-term projects in a multi-phase manner with adequate resources. The development of the park should be guided by a master plan. The key success factors that are commonly recognized in successful science and technology parks include:

- Clarity of vision and purpose amongst all stakeholders, with a consistent emphasis over time;
- The central involvement of at least one major research organization;
- Research and innovation as central in the branding of the park and in shaping its culture;
- Strong interaction between the host academic/research campus and park;
- A project champion (an individual or a group), with a clear and practical understanding of the park's purpose and the benefits it will bring;
- A park manager with strong leadership skills and preferably a background in R&D;
- The effective economic and social integration of the park with the community and region;
- Government playing a key leadership, facilitation and enabling role;
- Sufficient capitalization to ride out any adverse effects of the business and property cycles;
- Financial self-sufficiency over time;
- A multi-phased, development period of 15 or more years;
- The starting phase is critical to long term success; and
- Absence of development constraints and an ongoing availability of substantial space.

[46] Based on Kirk, Chris M. and Catts, Brian C., op.cit.

Strong research/academic backing of the park is a must in the knowledge-based economy

While traditional technology parks were not always integrated into a strong academic or research institution, this is becoming the park's most essential ingredient in the knowledge-based economy.

- The generation and application of knowledge are becoming the main drivers of growth and wealth creation in the modern economy.

- Competitive new products and technologies with a commercial potential – and a potential for growth of the firms that commercialize them – as a rule have a solid knowledge component.

- A large number of such new products and technologies have been developed and commercialized by start-up firms that have spun out of universities or large research institutions.

- The institutional arrangement of the science and technology park, which implies close partnerships and linkages between the academic institution and industry, creates a breeding environment for the generation and commercialization of innovation.

Stages of the development of science and technology parks[47]

A typical park takes around a decade to reach maturity passing through a series of recognisable phases:

- The initial phase, which may take a few years, encompasses the initial planning and agreement from the park's stakeholders, and the acquisition of funds sufficient for the commencement of operations.

- The second phase is one of steady growth and expansion in space, facilities and occupancy. During this phase, the management and operational activities of the park develop progressively and become more efficient. Some parks remain in this phase, with steady growth and stable management.

- Potentially, there is also a third, "mature" stage, with a change towards a more individual style of operation of the science and technology park, which differentiates it from others.

[47] Allen, John, op. cit.

Some key actions for successful science park management[48]

- Parks must become essential parts of the "innovation eco-system"; to achieve this, parks should be open to cooperation with others.
- A park would benefit from being integrated into the region's development plans, thus contributing and being part of community development.
- The high quality of senior park management is essential for defining a long-term strategy with clear objectives.
- The science park should be a gateway and not a destination - thus the managerial focus should be on the park's present and future dynamics.
- Success in the future hinges on opportunities cultivated today; in turn these depend on the overall ambience of the park, the services provided, the networking opportunities, etc.
- The park must be managed as a financially and environmentally sustainable business.
- Relationships with the key associated university or other academic institutions should be two-way: the university should accept the park as an essential partner, and the park should help in shaping the university's curricula.
- The park should build active networks of all kinds and at all levels, and measure their effectiveness.
- The park should establish an understanding of each tenant's needs and provide access to networks and services to help meet them, especially services offering commercial advice and support.
- The park can only benefit from efficient incubation facilities ensuring that 'graduation' from the incubator is a smooth and positive process.

[48] Adapted from a set of conclusions put forward by a panel of experts participating in the scenarios workshop "Third Generation Science Parks", held at Manchester Science Park 4 October 2006 (see Allen, John, op. cit.).

Evaluating the performance of science and technology parks

There is no standard method for evaluating the success or failure of science and technology parks; moreover, there are no established definitions of success/failure or standard ways to evaluate its effect on the local economy (see also Box K4.3.). The few studies that have attempted to analyse success or failure tend to focus on the returns of the park to its main stakeholders.[49]

Returns to the parks' tenant firms. Possible performance indicators include:

- Rates of successful knowledge transfer;
- Rates of commercialization of innovation;
- Emergence of new entrepreneurs;
- Extent of internal and external networking and science-industry linkages;
- Survival rate of new start-ups;
- Amounts of attracted external investment; and
- Growth and financial success of tenant firms.

Returns to the local economy. Possible performance indicators include:

- Number of new jobs generated;
- Amounts of attracted external investment;
- Tax revenue generated by tenant firms;
- Effects on the development of the local technological capability;
- Public image and perception of the region; and
- Indirect benefits related to the park (e.g. investment in other businesses related to networking with the park).

Returns to the park itself. Possible performance indicators include:

- Number of new jobs generated;
- Numbers of attracted successful tenant firms;
- New university curricula related to park activities;
- Number of joint university-industry patents;
- Amounts of attracted external investment;
- Growth and development of the park's technical infrastructure;
- Financial self-sufficiency/success of the park; and
- Public image and perception of the park.

[49] See Briggs, Anne Theodore and Watt, Stephen (2001), "Evaluating Technology Parks", mimeo (available at http://www.american.edu/carmel/ab5293a/Evaluation/evaluation.htm).

In addition, when the effect of policy measures seeking to develop science and technology parks or to enhance their efficiency is to be evaluated, the list of possible indicators for performance evaluation can be expanded to include the following (all indicators can be taken both in absolute terms and in proportion to the allocated public funds):[50]

- Number of technical cooperation agreements between universities/R&D organizations and industry (within and outside the park);
- Number of commercial and manufacturing agreements between universities/R&D organizations and industry (within and outside the park);
- Number of long-term cooperation links including park tenants (within and outside the park); and
- Number of long-term alliances that include external members.

D. Innovation clusters

An innovation cluster is a system of close links between firms and their suppliers and clients, and knowledge institutions, resulting in the generation of innovation (see Box K4.4.). The cluster includes companies that both cooperate and compete among themselves. The links between firms are both vertical, through buying and selling chains, and horizontal, through having complementary products and services, and use similar specialised inputs, technologies or institutions, and other linkages. Most of these linkages involve social relationships or networks that produce benefits for the firms involved. Clusters become even more visible and attractive if they have strong linkages with related clusters in other regions and countries

Clusters are based on systemic relationships among firms. The relationships can be built on common or complementary products, production processes, core technologies, natural resource requirements, skill requirements, and/or distribution channels. However, clusters are much more than just business networks. Business networks are generally closed organizations, generating external economies for members by sharing costs of resources, expertise and information.

Cluster initiatives are organized efforts to increase the growth and competitiveness of clusters within a region, involving cluster firms, government and/or the research community. A cluster initiative involves:[51]

- Different member organizations (four main types of actors: private industry, public organizations, academia, and public-private, typically non-profit, organizations);
- The cluster organization with an office, cluster facilitator/manager, website etc.;
- Governance of the initiative (e.g. constellation of a board; facilitator, etc.); and
- Financing of the initiative (national/regional/local public funding, members' fees, consulting, etc.).

[50] As one of the main targets of innovation policy is to enhance industry-science and industry-industry linkages, most of the specific policy-related performance evaluation indicators are of this nature.

[51] Sölvell, Örjan; Lindqvist, Göran and Ketels, Christian (2003), *The Cluster Initiative Greenbook*, Stockholm: Ivory Tower (www.cluster-research.org).

Box K4.5. The main features of innovation clusters

The notion of clusters is usually associated with some key elements and features such as:[52]

- Geographical concentration: firms locate in geographic proximity attracted by factors such as external economies of scale, social capital and learning processes.
- Specialization: clusters are centred around a core activity to which all actors are related.
- Multiple actors: clusters and cluster initiatives do not only consist of firms, but also involve public bodies, academia, financial intermediaries, institutions promoting collaboration, etc.
- Competition and cooperation: the interactions between the interlinked actors are characterized by both types of relations.
- Critical mass: the cluster needs to reach a certain size to achieve inner dynamics.
- The cluster life cycle: clusters and cluster initiatives are ongoing phenomena with long-term perspectives.
- Innovation: firms in clusters are usually involved in processes of technological, commercial and/or organizational innovation.

***Clusters are open and derive external economies from the market*:**

- Co-location encourages the formation of contacts between firms and can enhance the value creating benefits arising from networks;

- There may even be multiple operating relationships, with regional, national and even international dimensions to some clusters;

- Clusters affect competition in different ways: by increasing the productivity of companies based in the area; by driving the direction and pace of innovation; by stimulating the formation of new businesses within the cluster;

- Clusters enable companies to choose the location of their activities based on underlying economic efficiency, and not in response to artificial barriers for cross-border trade and investment;

- Clusters reach their full potential, when there is both competition and cooperation among its participants; and

- Clusters can leverage this potential if they create linkages with other clusters that provide complimentary capabilities.

[52] Andersson, Thomas; Serger, Sylvia Schwaag; Sörvik, Jens and Hansson, Emily Wise (2004), *The Cluster Policies Whitebook*, International Organisation for Knowledge Economy and Enterprise Development (IKED).

***Depending on the type of integrating links, there are two basic types of clusters*:**

- Vertically-integrated clusters made up of industries that are linked through buyer-seller relationships.

- Horizontally-integrated clusters, including industries which might share a common market for the end products, use a common technology or labour force skills, or require similar natural resources.

***Is there a typical cluster initiative*?**[53]

- Every cluster initiative is unique depending on local environment, range of objectives, financing and organization. However, some ways of choosing objectives and organizing the process lead to better performance.

- Most cluster initiatives are found in: information technology, medical equipment, production technology, communications equipment, biopharmaceuticals, and the automotive sector.

- Most cluster initiatives are found in national environments where science and innovation promotion is an important part of government policy, and where local government plays an important role.

- Most cluster initiatives are of regional importance and often of national importance.

- Cluster initiatives are initiated by: government (32%); industry (27%), by both (35%).

- Financing comes primarily from: government (54%), industry (18%); both (25%).

- Companies are the most influential parties in the governance of cluster initiatives. Only in rare cases does the government initially pick the members of the cluster initiative.

- Cluster initiatives tend to have a narrow geographical focus (50% have most of their members within one hour's travel distance).

- Cluster initiatives typically have a broad membership and rarely exclude foreign owned companies, competitors, or small companies.

- Almost all cluster initiatives (89%) have a dedicated facilitator, and many (68%) have some sort of office. Cluster facilitators tend to have an industry background from the cluster.

[53] Based on Sölvell, Örjan; Lindqvist, Göran and Ketels, Christian (2003), op.cit.

- In most cluster initiatives (78%), key stakeholders spend time and effort to build a framework of shared ideas about why the Cluster Initiative is beneficial and how it is supposed to work.

- 95% of cluster initiatives have ten active members or more. 40% depend for their future success on one key individual.

The benefits of cluster initiatives[54]

The interest in cluster initiatives – both by policymakers and the private sector – is instigated by the prospects of potential benefits such as:

- Increased levels of expertise both for the cluster as a whole and for its members;

- Enhanced opportunities for the diffusion of information and knowledge;

- Increased potential of inter-firm learning and cooperation for sourcing companies;

- The ability of firms to draw together complementary skills in order to jointly undertake larger projects;

- The potential for economies of scale to be realised by further specialising production within each firm and increased inter-firm cooperation;

- Competition stimulates efficiency gains within and between clusters;

- Establishment of a pool of specialised high-skill labour;

- Enabling the development of an infrastructure of professional, legal, financial and other specialist services;

- Strengthening social and other informal links, leading to the creation of new ideas and new businesses;

- Emergence of virtuous circles through enhanced specialization and new firm creation;

- The presence of long-standing and demanding customers supports the supply of high-quality goods and services;

[54] Based on *Practical Guide to Cluster Development*, Report to the Department of Trade and Industry and the English RDAs by Ecotec Research & Consulting, 2003 (http://www.berr.gov.uk/files/file14008.pdf); *Cluster Management Guide – Guidelines for the Development and Management of Cluster Initiatives*, CLOE - Clusters Linked Over Europe, 2007 (http://www.clusterforum.org/ media/CLOE_Clusterguide.pdf); Andersson, Thomas; Serger, Sylvia Schwaag; Sörvik, Jens and Hansson, Emily Wise (2004), *The Cluster Policies Whitebook*, International Organisation for Knowledge Economy and Enterprise Development (IKED).

- New business formation, filling in niches and expanding the boundaries of the cluster;
- Broader and faster innovation activity through cooperative research and more intense competition;
- Improved information flows within a cluster, allowing better match-making and reducing business uncertainty and risk;
- Greater competencies for handling risk in the formation of new ventures;
- Increased productivity and better employment opportunities in the region as a whole;
- Opportunities to attract complementary skills, technologies and funding from outside; and
- Increased opportunities to attract external investment, including FDI.

***Clusters breed an environment conducive to innovation*:**

- The cluster environment stimulates knowledge spillovers across institutional boundaries and encourages cooperation, both of which are essential for 'open innovation' generated in networks of cooperating companies and institutions.
- Competitive pressure resulting from the presence of firms in related industries also fosters the innovative activity of individual firms.
- Clusters stimulate the identification of new technology trends and potential innovation; lower the barriers for transforming new ideas into businesses and shorten start-up times.
- The cluster environment is conducive to learning and developing new competencies essential for the generation and commercialization of innovation.
- Clusters provide opportunities for pooling of innovation-related risk and a broad set of options to appropriate the benefit of investments in innovation.

***The main ingredients of a well-functioning innovation cluster*:**

- The presence of functioning networks and partnerships that facilitate linkages;
- A strong innovation base, with supporting R&D activities;
- Human capital endowment - a strong skills base;
- Well developed and functioning physical infrastructure and communications;
- Presence of large firms shaping the specialization of the cluster;
- Favourable business climate, competitive business environment and spirit of entrepreneurship;
- Access to finance, business support and specialist services; and

- Leadership and managerial skills.

Why are large firms important in clusters?

Large firms within clusters can play a catalytic role in a number of respects:[55]

- They create a critical mass of experienced managers and workers;
- They can provide a customer and supplier base;
- They provide ideal conditions for high technology firms to grow and develop; and
- They have multiplier effects in terms of a region's local economy for materials and services (these can range from university graduates to office supply services to raw materials' production).

The broad class of cluster policies refers to public interventions seeking to facilitate clustering

- Cluster policies involve a variety of instruments, integrated under the common denominator of the territorial dimension (see Box C4.4. on cluster policy instruments in France).

- Most cluster policy interventions rely on knowledge spillovers and externalities generated through proximity.

- Clusters produce 'hard' externalities such as a larger pool, greater variety, and lower costs of supplies and components, specialised and customised services, skilled labour, and potential partners, as well as 'soft' externalities such as access to tacit knowledge, technologies, markets, and opportunities to network, and to aggregate interests and needs.

- Knowledge spillovers and externalities are conditioned by local circumstances such as a specific organizational and cultural environment.

[55] *Practical Guide to Cluster Development*, op.cit.

Box C4.4. Instruments of public support to innovative clusters (pôles de compétitivité) in France [56]

A total of 71 clusters in France have been officially recognized as "pôles de compétitivité". In 2007, 5,000 companies were cluster members; 80% of these were SMEs. The French Government provides support to cluster development at both local and national levels in the following ways:

- Grants from the Inter-ministerial Fund for outstanding research and development projects selected after a semi-annual call for proposals;
- Partial financing for cluster governance structures, alongside local authorities and companies;
- Financial support for theme-based collective actions initiated by clusters in a wide range of areas, via the various Regional Directorates for Industry, Research and the Environment (DRIRE);
- Preparing guidebooks such as « Les bonnes pratiques de gouvernance pour les pôles de compétitivité » ('Good governance practices for competitive clusters') and « Le guide pratique de la propriété intellectuelle dans les pôles » ('A practical guide to intellectual property in clusters');
- Providing financing for R&D projects led by competitive cluster stakeholders;
- Facilitating cooperation with public research centres; and
- Encouraging local authorities to provide financial support for a cluster's R&D projects.

A total of €1.5 billion has been earmarked for the clusters from 2006 to 2008, including €300 million in social security and tax exemptions. A full €400 million will be in appropriations from different ministries and €800 million will be financed jointly by the National Research Agency, the Agency for Industrial Innovation and the OSEO group.

Types of cluster policies

While the types and contents of cluster policy may vary considerably from country to country (Box C4.5.), three main types can be distinguished: [57]

- A first type deals with the strengthening of `triple helix´ relationships, particularly between industry, research and government agencies, such as regional development agencies or science and technology agencies.

- A second type focuses instead on R&D cooperation between companies and between companies and research organization.

[56] "Competitive Clusters in France", French Ministry of Economy, Finance and Industry, Directorate General for Enterprise (http://www.industrie.gouv.fr/poles-competitivite/brochure-en.html).

[57] *Cluster Management Guide – Guidelines for the Development and Management of Cluster Initiatives*, CLOE - Clusters Linked Over Europe, 2007 (http://www.clusterforum.org/media/CLOE_Clusterguide.pdf).

- A third type concentrates on encouraging cooperation among companies, regardless of whether these collaborations take place with R&D-institutions or are carried out either horizontally between competitors, or vertically along the value chain.

Box C4.5. Cluster policy initiative in selected UNECE countries [58]

Czech Republic

The Government has adopted a cluster development programme which lays down basic rules and conditions of providing support in the form of direct subsidies to projects whose aim is to support economic growth and competitiveness in the economy through development of sectoral associations – clusters that can be created at regional, up-regional or cross-border levels. Public support for the development of clusters is provided in the form of a subsidy for a maximum eight months period after the registration of the application for support. Applications for subsidies are accepted on an on-going basis with CzechInvest (one of the main implementing agencies of the programme). Subsequently, the applications for public support are submitted for decision to a Selection Committee. Cluster initiatives usually contain two phases: 1) Mapping, whereby support is provided for seeking out firms potentially interested in participating in clusters. Between 2004 and 2008, 27 new legal entities were established under this framework. 2) Cluster establishment, which stipulates the establishment and further development of clusters. By mid 2008, 12 such clustering projects were supported by CzechInvest.

Hungary

In Hungary, clustering policy initiatives are part of the broader policy objective to increase the R&D activities of firms and boost innovation. Both direct and indirect policy measures are in place, which are targeted to create knowledge/innovation clusters, with the implicit expectation to establish about 8-12 such clusters by 2010. The direct policy measures to promote the networking capabilities of Hungarian firms include: support to joint university-industry projects, support to technological innovation in supplier networks; innovation programme for cutting-edge industries and support for the development of incubator houses. In turn, the "Competitiveness Poles" project is a large scale policy initiative (a total budget of up to €400 million for the period 2007-2013), seeking to assist the establishment of clusters of universities, research centres, multinationals and small firms in seven cities in a high-technology areas (such as biotechnology and information technologies). This policy initiative encourages the formation of clusters as public-private partnerships.

[58] *Sources*: documents submitted by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies; Richter Miroslav, "Cluster Initiatives in the Czech Republic", Presentation at the Investment Promotion Seminar, Prague, 9–10 April 2008; Békés, Gábor, "Clusters, Science Parks and Regional Development: Strategies and Policies in Hungary", Presentation at the second session of the UNECE Team of Specialists on Innovation and Competitiveness Policies, Geneva, 14-15 February 2008; Ministry of the Economy of the Republic Slovenia, "Slovene Experiences on Cluster Policy", Presentation at the TCI Dialogue Symposium on Cluster Policy Renewal, San Sebastian, May 2007; Innovating Regions in Europe (IRE) Network. An overview of Cluster Policies and Clusters in the New Member States of the European Union, mimeo (available at http://www.innovating-regions.org/download/Clusters_in_CCE.pdf).

Latvia
Public policy in Latvia considers clusters as an instrument to enhance industrial competitiveness. Various policy initiatives seek to instigate a dialogue with and among the industry to improve the overall business environment and to deliver more direct assistance to cluster development in areas that have been identified as priorities due to their potentials in terms of knowledge-intensive and competitive advantages. The first initiative to identify and promote development of industrial clusters was the project, "Support to Industrial Cluster Restructuring" (2000-2002), which identified and supported the establishment of four broad clusters: Forestry, Information Technology, Engineering and High-Technology. Public support was mostly directed towards the coordination of clustering activities, the identification of existing imperfections in the business environment; international PR/marketing and export promotion, and strengthening the collaboration between industrial enterprises and science/education sectors. The Latvian Investment and Development Agency was restructured in order to concentrate available resources more efficiently on the development of industry clusters. A new cluster development programme will start in 2008.

Poland
Cluster policy in Poland was given a boost in 2002 with the undertaking of an analysis of industrial policy clusters and potential policy instruments. The importance of supporting clusters was highlighted in the "Strategy for Increasing the Innovativeness of the Economy for 2007-2013", accepted by the Government in 2006. The strategy envisages support for networking of entrepreneurs aimed at implementation of innovative undertakings and, in particular, the support to the development of clusters, technological platforms in technologically advanced sectors and strengthening the cooperation between the research and development sector and the economy.

The existing Polish clusters in traditional and high-tech branches have a strong regional element, with spontaneous bottom-up networking. Emerging regional formations show a strong similarity to clusters, especially in high-technology sectors. One of the recent instruments in the framework of cluster policy in Poland was a pilot programme of the Polish Agency of Enterprise Development (PAED) "Support on cluster development". The aim of this programme is to reinforce the competitiveness of existing cluster structures, which indirectly or directly influence economic and social development of the whole region. In total, 49 applications were received out of which five projects were selected for funding.

Portugal
The National Programme for Action and Jobs (PNACE), identifies clusters as important components of the policy to promote international competitiveness. The programme contains four sets of measures to promote cluster development. Measure 11 – Fostering Business Cooperation; Measure 12 – Orienting public procurement towards the integration of national companies in international consortia and value chains (mainly technological development and innovation); Measure 13 – Relaunch of the Dínamo Programme, aiming at associating the textile, clothing and leather industries with design and distribution, in order to develop the fashion cluster; and Measure 14 – Reinforcing the Tourism cluster.

Slovenia
The first cluster policy initiatives in Slovenia were launched in 1999, to identify potential clusters of strategic importance for the country. In 2000, the Ministry of the Economy launched a pilot programme of cluster development with the aim of developing a systematic approach to cluster development, to promote and strengthen the cluster policy and to gain experience. It focused on three pilot clusters: automotive, transport and logistic, and a machine tooling cluster. During the period 2001-2005, the related policy interventions sought to support and stimulate the networking and clustering of enterprises and to enhance interaction between enterprises both within and among clusters. In 2007, the Government adopted a new Programme for Entrepreneurship and Competitiveness for the period 2007-2013. All in all during these years, some 28 clusters were initiated in Slovenia including four technology networks and 17 cluster offices for the management and coordination of cluster development projects. At a national level, implementation is coordinated by the National Center of Clusters and Technology networks.

Cluster policies are dependent on the stage in the cluster life cycle

Clusters have life cycles, which progress from:

- Embryonic clusters – those at the early stages of growth.
- Established clusters – those perceived as having room for further growth.
- Mature clusters – those that are stable or will find further growth difficult.
- Declining clusters – those that have reached their peak and are failing or declining.

The interventions that are appropriate at an early stage in the lifecycle of a cluster are likely to differ from those appropriate at later stages. Annex II contains a set of policy recommendations relevant for the different stages of the cluster life cycle.

Clusters are not necessarily defined by organizational membership

- While an association provides members with many real benefits, 'free riders' may also be a part of the cluster and may enjoy benefits similarly to members of the cluster associations.

- Clusters are mostly defined by relationships. Ultimately, they are self-selecting based on how individual employers and institutions in a region define their missions, set their priorities, use their region's resources, and form relationships.

- Many successful clusters were the outcome of circumstances; public policies may have been the catalyst but not always with the intent of starting a cluster (see Box C4.6.).

- Among the key drivers for the launching of a clustering initiative is the presence of functioning networks and partnerships and a motivated core among them.

- The growth of large and successful clusters is usually driven by market demand and entrepreneurial spirit. Some began as large companies that originally located in less populated areas to take advantage of low wages and surplus labour markets and that later disintegrated into smaller firms (see also Box C4.7.).

Box C4.6. Three Polish clusters[59]

As indicated by the Polish experience, an important factor that generates and improves cluster-relevant linkages for firms' innovative performance is the promotion of the cluster idea among small and medium-sized enterprises. Also, networking is considered as a crucial component of Polish clusters, allowing local firms, especially small and medium-sized enterprises (SMEs), to enhance their innovativeness and strength through aggregation. Current policies to support enterprises, especially SMEs, play an important role in fostering networking and clustering in Poland.

1. The Aviation Cluster in Rzeszów (Podkarpackie)
The Podkarpackie region has 100 years of aviation industry history, starting as a producer of small aircraft and later helicopters during the communist era when it was also a centre for pilot training. After the start of economic and political transformation, the local companies quickly went looking for investors to capitalise on their experience, 16,000 trained employees and specialised academic links. This search for international partners/investors paid off for the aircraft engine maker WSK PZL Rzeszów, which quickly began collaborating with the United Technologies Corporation from the US (and was bought by them in 2002). Since that time, WSK PZL Rzeszów has taken the lead in building the Aviation Valley cluster, introducing new thinking and investing in local start-ups. Cluster members are now producing parts for the aviation industry worldwide, including Airbus in Europe, and cluster membership is now 50 companies. The cluster is backed by cooperation with the Faculty of Mechanical Engineering and Aeronautical Engineering at the Rzeszów University of Technology, which is the pivotal educational and research institution. The mission of the Aviation Valley Association is the transformation of south-eastern Poland into one of Europe's leading aerospace regions, which would be able to provide a diverse cross section of products and services for the most demanding clients. The mission is spelled out in the operational objectives such as: organization and development of a low cost supply chain; creation of favorable conditions in order to enhance the development of aerospace industry enterprises in this region; further development of aerospace research, aptitude and skill; cooperation with universities of technology, which would promote new ideas and scientific research within the aerospace industry; promotion of the Polish aerospace industry; protection of businesses in the aerospace industry; and lobbying on related economic policy issues.

2. The Furniture Cluster in Wielkopolskie
The furniture cluster in Wielkopolskie covers all aspects of the supply chain, from specialized research facilities such as the Institute for Wood Technology in Poznan and the Institute of Natural Fibres, through subcontractors such as paint and chemical suppliers, to the furniture manufacturers themselves – in all covering 3,700 businesses. Furniture manufacture has a long history in the region with many of the research institutes dating from the middle of the 20th century. During communism, the manufacturers had strong links with the research institutes, but during the transition to a market economy these were lost and are only now being re-established. Furniture manufacturers themselves took the initiative to form a cluster in cooperation with Poznan University of Economy. There have been obstacles to cooperation between the furniture manufacturers because of competition and IPR

[59] *Source*: documents submitted by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies.

concerns as well as poor experiences in the past. However, this is changing as more and more cluster members realize that cooperation can promote competitiveness. To help overcome these barriers, the cluster members appointed the Wielkopolska Agency for Enterprise Development to act as the 'cluster broker' to promote cooperation within a cluster.

3. The Pomeranian ICT Cluster
The mission of the Pomeranian ICT Cluster is **'**to create and develop an ICT cluster which would combine business and scientific environments as partners to jointly create a leading region in Poland, and which would internationalise the region's business and services worldwide'. The policy push for the formation of such a cluster in the Pomeranian Voivodeship comes from the Regional Innovative Strategy which highlighted information and telecommunication technology (ICT) as one of the key regional priorities. The region has a reputation for excellence in ICT university training and research. In addition, there are over a hundred ICT companies operating in the area working on numerous research projects. Clustering initiatives within the Pomeranian ICT Cluster can take different forms such as: submitting new innovations regarding new business, building a prototype of a device, creating a new concept or a research project; joining an already existing collaborating network; participation in related project events; match-making among potential partners; supply networking and linkages; knowledge and data sharing.

***Growing and innovative cluster environments are typically driven by a strong "diamond", which involves*:**[60]

- Intense local rivalry involving battles of prestige and "feuds," stimulating continuous upgrading and creating a foundation for a more advanced and diverse supplier base.

- Dynamic competition emanating from the entry of new firms, including spin-offs from larger incumbents.

- Intense cooperation organized through various institutions for collaboration such as professional organizations, chambers of commerce, cluster initiatives, etc. Dynamic clusters also exhibit intense informal interaction based on personal networks.

- Access to increasingly specialized and advanced factors of production (human capital, financial capital, infrastructure) and for many clusters, linkages with universities and public and private research institutions.

- Linkages to related industries, sharing pools of talent and new technological advancements. Proximity to sophisticated and demanding buyers.

[60] Ketels, Christian and Sölvell, Örjan (2006), *Clusters in the EU-10 New Member Countries*, Europe INNOVA (ftp://ftp.cordis.europa.eu/pub/innovation-policy/studies/docs/studies/eucluster.pdf).

Strong clusters emerge and flourish in open markets where competition coexists within and between clusters[61]

- Clusters emerge where competition across regions enables companies to locate activities based on underlying economic efficiency.

- Artificial barriers that influence cross-boarder cooperation and trade weaken cluster concentration and specialization.

- Other factors that drive the growth of innovation clusters include: agglomeration economies; local labour force skills; environment for technology transfer and knowledge spillover; social infrastructure.

The menu of possible policy actions to support the emergence of cluster initiatives and the development of clusters includes:[62]

- Actions for understanding and benchmarking regional economies
    - Identify clusters
    - Model and map systemic relationships
    - Benchmark against competitors
- Actions for engagement
    - Recognize or, where an unmet need exists, create cluster associations
    - Formalize communications channels
    - Foster inter-firm collaboration
- Actions for organizing and delivering services
    - Organize and disseminate information by cluster
    - Establish one-stop cluster hubs
    - Form cross agency cluster teams
    - Create cluster branches of government
    - Facilitate external connections
- Actions for building a specialised work force
    - Qualify people for employment
    - Use clusters as context for learning

[61] European Cluster Alliance (2007), "The European Cluster Memorandum. Promoting European Innovation through Clusters" (http://www.proinno-europe.eu/NWEV/uploaded_documents/Cluster_Memorandum.pdf).

[62] Rosenfeld, Stuart A. (2002), "Creating Smart Systems. A Guide to Cluster Strategies in Less Favoured Regions", mimeo (available at http://ec.europa.eu/regional_policy/innovation/pdf/guide_rosenfeld_final.pdf).

  - Establish cluster skill centres
  - Form partnerships between educational institutions and clusters
  - Support regional skills alliances
  - Create inter-regional cluster alliances

- Actions for stimulating innovation and entrepreneurship

  - Invest in innovation and business start-ups
  - Support cluster based incubators
  - Encourage entrepreneurs' networks
  - Innovation networks
  - Establish cluster-based technology hubs

- Actions for marketing and branding a region

  - Target inward investment
  - Promote clusters
  - Form export networks
  - Look for opportunities to brand regions

- Actions for allocating resources and investments

  - Give incentives or set aside funds for multi-firm projects only
  - Invest in cluster R&D
  - Fund critical foundation factors.

***Checklist of key questions to address in launching a clustering initiative*:**[63]

- What do we want to achieve through the strategic alliance or cluster?
- Can we use other means to reach our goal?
- What partners does the project need?
- Do the partners have sufficient economic, organizational and innovative capacity?
- What benefits (strengths) are the partners bringing into to the network?
- What benefits does the network offer its partners?
- What existing successful or solid strategic alliances can the network build on?
- Is the "chemistry" between the partners right?
- What trust-building measures are required?
- Are the goals and functions of the strategic alliance or network clear to all the relevant stakeholders?

[63] Scheer, Günter and von Zallinger, Lucas (2007), *Cluster Management – A Practical Guide*, prepared for Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (http://www2.gtz.de/dokumente/bib/07-1496.pdf).

***Main steps in cluster development*:** [64]

- Step 1. Analyze local economy: Identify the embryonic and the more developed local clusters and prioritise which ones to initially concentrate on.
- Step 2. Initial cluster stocktaking: Gather information about the cluster in the local economy.
- Step 3. Establish the leadership team: Carefully choose the appropriate people to participate in the leadership group.
- Step 4. Develop cluster vision: Establish the preferred future for the cluster.
- Step 5. Identify stepping stones: Identify the key steps to the preferred future.
- Step 6. Immediate action agenda: Highlight the short-term projects.
- Step 7. Institutionalise the cluster: Set up an institution/organization which will sustain the clustering process into the future.
- Step 8. Upgrading the strategic agenda: Move to longer-term, more substantive projects.

***The cluster strategy is the main long-term planning tool which should cover the following aspects*:**[65]

- Analysis of sectoral competitive situation;
- Systematic SWOT analysis (strengths, weaknesses, opportunities, threats) at the macro, meso and micro levels;
- Trend analysis (markets and technologies);
- International benchmarking;
- Analysis of cluster potential;
- Cluster vision;
- Cluster goals;
- Definition of the cluster's range of outputs;
- Organizational structure;
- Implementation strategy (steps);
- Monitoring and evaluation; and
- Action plan.

[64] *Cluster Building: A Toolkit*. Prepared by Cluster Navigators Ltd, 2001 (http://www.nzte.govt.nz/common/files/cluster-builders-toolkit.pdf).

[65] Scheer, Günter and von Zallinger, Lucas, op.cit.

Good practice in cluster development

Practical experience has identified some important lessons in efficient management of cluster initiatives and the development of clusters:[66]

- Clustering is a team activity, not a solo effort; its successful start requires a core of motivated enthusiasts who would also inspire others to join in.

- As a collaborative, team-driven initiative, clustering requires a fair sharing of the workload.

- Clusters are predominantly a local activity, and for development initiatives to be sustainable they should be driven by local organizations (see Box C4.7.).

- Early political support helps so the clustering initiative can only benefit from the early engagement of the top local authorities.
- Private sector leadership must follow: the actual cluster development process should be driven by the private sector (e.g. through a cluster facilitator), to the private sector.

- A key role in stimulating the development of clusters is the availability of a motivated and neutral cluster facilitator.

- To keep the momentum in cluster development, early initiatives are needed that generate early results; these need to be assigned high priority.

- A clustering initiative needs to be action-orientated, holding the commitment of stakeholders through generating benefits as early as possible.

- As a long-term venture, the cluster initiative needs to focus on meeting the needs of the firms that are at the core of the cluster. At the same time there needs to be a portfolio of wider cluster initiatives underway early on; generating benefits for a large number of cluster stakeholders.

- It is important to define 'cluster boundaries', focusing the activities on what has meaning for the cluster stakeholders.

- Long-term cluster sustainability requires trust among key stakeholders; social networks (both formal and informal) are vital for clusters to work efficiently.

- Additional resources are important to gaining private sector attention, especially in the early stages. This could include funding from government agencies, private sector organizations, or training programmes by local universities to support the cluster.

[66] Based on *Cluster Building: A Toolkit*. Prepared by Cluster Navigators Ltd, 2001 (http://www.nzte.govt.nz/common/files/cluster-builders-toolkit.pdf).

- Universities are key local players both as learning institutions and as technology generators, and generators of new spin-off companies.

- Informal or more formal cluster benchmarking provides a learning opportunity and helps build team spirit.

- Clusters provide an environment that attracts specialised investments, which then further enhance the location, therefore attracting new investment should be a key managerial priority.

Box C4.7. The media cluster of computer games market in Guildford (United Kingdom): a success story based on a local initiative

In 1991, two entrepreneurs took a small unit in the Surrey Technology Centre for their computer games company Bullfrog. The company funded its own computer games development programme by providing a contract service to some of the other large computer games companies. The company was able to utilise the capacity, in terms of storage capacity and multimedia facility, offered by the fast developing personal computer sector to create a new genre of game. Their proprietary games proved to be commercially highly successful and eventually attracted a buyer in the form of Electronic Arts, which bought Bullfrog. After a number of years of working for Electronic Arts one of the founders of Bullfrog left to start a new games studio which returned to the Surrey Research Park as Lionhead Studios. The new company grew - based on its success in publishing a number of games titles.

The success of their games and the lack of content for other 'games boxes' stimulated the interest of Microsoft, which then acquired Lionhead Studios. At the same time the original owner of Bullfrog has acquired another games company, known as Criterion Software that spun out of the Japanese company Canon's research facility that was located on the Surrey Research Park. Electronic Arts is now trading in Guildford as EA UK Ltd and contributes a significant number of employees to the cluster of those involved in computer games in Guildford. The Surrey Technology Centre has now also attracted NikNak games and Kudu Games, two further computer games companies to the site. The University of Surrey is building on this cluster by designing courses that offer modules to meet the needs of the employers in this cluster.

The cluster facilitator is the central figure in launching, developing and managing cluster initiatives

The cluster facilitator should be a neutral broker (with no vested interest in any of the cluster companies or ventures) who has responsibility for instigating cluster development programmes, and ensuring that the initiatives continue to be upgraded. The facilitator needs to have:[67]

- Personal skills to motivate and empower senior cluster stakeholders;
- Ability to build long term relationships, and to motivate;
- Close working knowledge of the activities represented by senior stakeholders;

[67] *The Cluster Policies Whitebook*, International Organisation for Knowledge Economy and Enterprise Development (IKED).

- Knowledge of the clustering process, and of the resources available to support clustering initiatives;
- Credibility and integrity; and
- Flexibility to participate in many meetings that may be beyond normal working hours.

Cluster monitoring and evaluation

- As with any large-scale projects, monitoring and evaluation are important aspects of cluster management (see also Box K4.3.).
- Evaluation is necessary both to assess to what extent objectives are achieved and to identify the need for corrective action.
- Monitoring and evaluation are helpful both in assessing the impact of cluster policy measures and for benchmarking cluster performance.
- Evaluation may involve both quantitative and qualitative analysis. Quantitative evaluation requires measurable indicators to be determined in advance.

Some benchmarking indicators for cluster initiatives[68]

Key figures

- Number of partner companies in the cluster initiative.
- Cumulative turnover of partner companies of cluster initiative.
- Cumulative number of employees of partner companies in the cluster initiative.

Qualification

- Number of organized events within the cluster initiative.
- Number of companies participating in these projects in the cluster initiative.

Cooperation projects

- Number of collaborative projects (technical cooperation, technical assistance, commercial agreement, manufacturing agreements, etc.) in the cluster initiative.
- Number of joint ventures, including such with external partners.
- Number of participants in these projects.
- Number of projects involving integration of companies and specialization in value chains.

Networking

- Number of local network projects.

[68] Adapted from *Cluster Management Guide – Guidelines for the Development and Management of Cluster Initiatives*, CLOE - Clusters Linked Over Europe, 2007 (http://www.clusterforum.org/media/CLOE_Clusterguide.pdf).

- Number of participants in these projects.
- Number of coordinators trained to support cluster and network development.
- Number of cluster offices.

Box C4.8. illustrates a system of indicators that can be used to evaluate some aspects of cluster performance.

Box C4.8. System of indicators to evaluate cluster management and performance in Romania [69]

The annual evaluation of cluster performance is based on a system of indicators established jointly by the management of the cluster and the inter-ministerial working group overseeing policy implementation. The following indicators can be used to evaluate aggregate performance of the cluster:

Aggregate cluster performance:

- Total value added/turnover of participating firms (in absolute level)
  - of which, generated in collaborative cluster projects (%)
- Annual growth of total value added/turnover of participating firms (%)
  - of which, generated in collaborative cluster projects (%)

Fixed capital and investment:

- Total fixed capital of participating firms (in absolute level) of which:
  - capital in new technologies (%)
  - capital in joint ventures and projects (%)
- Total fixed investment of participating firms in the year (in absolute level) of which:
  - investment in new technology (%)
  - investment in joint ventures and projects (%)
- Total R&D expenditures of participating firms in the year (%)
  of which:
  - R&D in collaborative cluster projects (%)

Human resources:

- Number of employees in cluster (total and by qualification levels) of which:
  - involved in research and development (%)
  - involved in collaborative cluster projects (%)
- Annual growth of employees in cluster (total and by qualification levels) of which:
  - involved in research and development (%)
  - involved in collaborative cluster projects (%)
- Number of employees in cluster who participated in training events in the cluster

Efficiency and profitability:

- Value added/turnover per employee
  - in cluster as a whole
  - in collaborative cluster projects

[69] *Practical Guide for Setting up Clusters in Romania*, Contribution by members of the UNECE Team of Specialists on Innovation and Competitiveness Policies (Romania).

- Value added/turnover per one unit of fixed capital
  - in cluster as a whole
  - in collaborative cluster projects
- Average total costs per one unit of total turnover
  - in cluster as a whole
  - in collaborative cluster projects

Total before tax profit per one unit of total turnover/fixed capital.

***Checklist of key issues to address in cluster evaluation*:**[70]

Apart from quantitative benchmarking, the evaluation should include also qualitative analysis structured along important issues, such as:

- Has the cluster reached its goals in terms of the desired result, costs and deadlines?
- Have those responsible enough information to measure the cluster's performance and success?
- Are all relevant stakeholders satisfied with the results?
- What has gone well, what not well?
- How do the partners and other important stakeholders evaluate cooperation within the cluster and cooperation with customers and important interest groups?
- What general conclusions do partners draw from the work for planning and implementing future projects or the future work of the cluster?
- Do cluster partners appreciate enough the successes achieved?

Table 4.7. illustrates the framework of the whole process of cluster monitoring, benchmarking and evaluation based on juxtaposing cluster inputs or 'drivers' with outcomes or results.

[70] Scheer, Günter and von Zallinger, Lucas (2007), op.cit.

Table 4.7. An illustrative framework for cluster monitoring, benchmarking and evaluation

Drivers		
Networks and partnerships	**Innovation and R&D**	**Human resources**
• Number of partnership arrangements • Number of cooperation agreements • Number of networking events • Number of joint research activities • Extent of social capital	• R&D employment • R&D expenditure • Number of business spin-outs • Number of patents applied for • Number of innovation awards • Number of new products/processes adopted	• Number of vacancies • Educational attainment rates • Number of defined qualifications • Extent of measured skills gaps
Outcome – Economy and enterprise		
• Net employment change • Increase in GVA/GDP • Growth of existing businesses • Number of firms within the cluster • Levels of investment • Levels of profitability • Value of exports		

Source: *Practical Guide to Cluster Development*, Report to the Department of Trade and Industry and the English RDAs by Ecotec Research & Consulting, 2003 (http://www.berr.gov.uk/files/file14008.pdf).

Recapping: can policy catalyze clusters? [71]

Policy has a major role to play not only in promoting cluster development but also in coordinating the efforts of the numerous stakeholders at the macro, meso and micro levels helping them commit to a common long-term vision for the cluster and understand their own role in its cluster.

The role of national governments:

- Play a role as 'broker', 'facilitator', 'initiator', 'participant' and 'listener' to engage partners in a productive dialogue and create a sense of urgency to cause action;

- Conduct ongoing cluster assessments to determine their viability and relative strength to ensure global competitiveness;

- Institutionalise cluster upgrading (e.g. through government programmes and services, facilitating the diffusion of new knowledge, collecting and disseminating data/information by clusters, etc.); and

[71] Adapted from *The Cluster Policies Whitebook*, International Organisation for Knowledge Economy and Enterprise Development (IKED).

- Directly invest in, and provide investment incentives for technical, physical and knowledge infrastructure.

The role of local authorities:

- Commit to establishing a competitive local environment;
- Build/encourage/facilitate local and global partnerships to attract knowledge-based firms; and
- Support clusters by promoting their inherent strengths/assets.

The role of business leaders:

- Lead and participate in the development of cluster strategies;
- Identify strengths and weaknesses of clusters; and
- Set higher aspirations pursuing global strategies.

The role of the academic community:

- Promote a culture of entrepreneurship among students and faculty;
- Focus on applied research and support the needs of local clusters through cluster analysis, training programmes, R&D; and
- Respond to the technological needs of cluster-based SMEs.

The role of cluster facilitators:

- Encourage synergies and build consensus;
- Maintain the balance of achieving short and long-term benefits; and
- Focus on concrete action plans for cluster specific initiatives.

ANNEX I

OPEN INNOVATION DIAGNOSIS TOOL

The UK Innovation Advisory Service South East and Oxford Innovation[72] have elaborated a diagnostic tool to help companies identify the use they make of open innovation and how they can increase effectiveness in this area. Thus, companies can see where they are positioned in the so-called "**Stepladder of Open Innovation"**'.

Step 3	Companies that make full use of Open Innovation systems to exploit their intellectual property via other companies where appropriate.
Step 2	Companies that demonstrate some components of Open Innovation but have yet to develop a strategic approach to its management.
Step 1	Companies that are aware of Open Innovation but have not yet developed a way to exploit their intellectual property via external customers when appropriate.
Step 0	Companies that do not recognize Open Innovation and do not consider external customers as an option for exploiting their intellectual property.

Two different sets of questionnaires, depending on whether the company is a buyer or a seller of innovation, are used. For each group of questions, companies are asked to provide the answer that best describes their situation. A score is then calculated to determine the position on the stepladder.

Open Innovation
Buyer's Stepladder

Technology and Business Sales	
We have realised significant financial benefits from our technology sales efforts	3
The financial benefit from our technology sales have been rather small	2
We have considered, but never previously progressed, any technology sales	1
Our company has never considered any technology sales as an exploitation option	0
Project Reviews	
We review all projects regularly to ensure that benefits outweigh the remaining costs	3
We expect to incorporate regular economic and technical reviews into our plans	2
We are reluctant to stop projects with poor prospects after investing large sums	1
We only tend to undertake project reviews when the funding is running out	0

[72] The questionnaire can be accessed online at www.iasse.co.uk/services/open-innovation-stepladder.

Market Understanding	
We never invest in any development without a detailed understanding of the market	3
When targeting unfamiliar sectors, we make special efforts to understand the market	2
We develop an understanding of the market alongside any technology development	1
Our focus is always on understanding the technology rather than the market	0
Intellectual Property Management	
We make sure our ideas are fully protected before approaching any potential buyers	3
We use NDAs and the possibility of patent coverage to protect our innovations	2
We don't expect to be able to patent our ideas but hope to protect our know-how	1
We have no mechanisms in place for protecting our innovations and/or know-how	0
Understanding User Needs	
We talk to potential users regularly to make sure that our innovations fit their needs	3
We have made a few efforts to understand the specific needs of potential users	2
We have not contacted potential users but believe that we understand their needs	1
We make no special effort to understand the specific needs of potential users	0
Technology Networking	
We are committed participants in several active technology networks	3
Part of our strategy is to increase participation in key technology networks	2
Some individuals are involved with a technology network on an ad hoc basis	1
Our company has had no participation in any technology networks	0
Sector and Investment Networks	
We are very active in several networks that could help us reach potential buyers	3
We are starting to participate in networks that could help us reach potential buyers	2
We will consider participation in networks as a way to reach potential buyers	1
We haven't considered any participation in sector or investment networks	0
Use of Intermediaries	
We are using intermediaries to help us find potential buyers for our innovations	3
We are starting to work with intermediaries that could help us exploit our innovations	2
We have very limited contact with intermediaries that could help us exploit our ideas	1
We have not considered using intermediaries to help us find buyers for our ideas	0
Using External Advisors	
We always use external advisors when we lack expertise on important issues	3
We sometimes use external advisors when we lack expertise on important issues	2
We would consider using an external advisor if we lacked specific expertise	1
We never use any external advisors, preferring to rely on our in-house expertise	0

Business Models	
We thoroughly review all options before deciding how to exploit our innovations	3
We are introducing procedures for deciding how best to exploit our innovations	2
We don't know how to select a best business model for exploiting an innovation	1
We will only consider in house routes for exploiting our innovations	0
Valuing Innovations	
We obtain a wide variety of inputs to judge the commercial value of our innovations	3
We are investigating the best way to assess the value of our innovations	2
We judge the value of our innovations from our expenditure and a suitable margin	1
We rely on the view of the selected buyer to judge the value of our innovations	0
Optimising Value	
We decide the best time to exploit our innovations by undertaking regular reviews	3
We market our innovations as soon as they have reached 'proof of concept' status	2
We market our product innovations as soon as possible after patenting	1
We are not sure what would be the best time to market our innovations	0
Opportunity Assessment	
We use a proven system for screening and evaluating development opportunities	3
We are trying to introduce new systems for screening and evaluating opportunities	2
We evaluate potential development opportunities on an ad hoc basis	1
We have no systematic way for screening or evaluating development opportunities	0
Competitor Analysis	
We study and compare all existing and new competitors to our product innovations	3
We compare our innovations against competitive products in the marketplace	2
We only develop innovations that are thought to offer price or performance benefits	1
We rely on the fact that our innovations incorporate more advanced technology	0
Market Assessment	
We make strong efforts to understand the market characteristics and its participants	3
We always study the size of the target market for our ideas and its growth prospects	2
We usually spend some time trying to understand the market for our innovations	1
We devote little effort trying to understand the market for our product innovations	0
Business Skills	
Our staff have all the business skills needed to develop and exploit our innovations	3
We have access to people with the skills needed to develop and exploit our ideas	2
We are building up the additional skills needed to develop and exploit our ideas	1
We are a technology-specialized organization with limited business skills	0

Product Marketing	
We use every possible means to ensure that prospective buyers learn of our ideas	3
We try to focus our efforts on direct contacts with a few prospective buyers	2
We try to raise awareness of our innovations through traditional advertising	1
We make no special effort to promote our innovations to potential users and buyers	0
Partner/Purchaser Agreements	
We fully investigate the integrity of potential partners before making commitments	3
We make discrete enquiries about potential partners before making any commitment	2
We rely on the public profile of potential partners when assessing their suitability	1
We believe the interests of ourselves and any potential partners will always coincide	0
Knowledge Transfer	
We have processes in place to ensure the transfer of essential knowledge to buyers	3
We are developing processes to ensure effective knowledge transfer to buyers	2
Processes for transferring knowledge to buyers will be established for each project	1
We have no processes in place to transfer knowledge of our innovations to buyers	0
Staff Incentives	
Our reward systems include major incentives for staff to encourage Open Innovation	3
We are introducing incentives for our staff to encourage Open Innovation	2
We are not sure how to encourage our staff to adopt Open Innovation	1
We have no incentives in place to encourage Open Innovation practices	0

Open Innovation
Seller's Stepladder

Technology and Business Sales	
We have realised significant financial benefits from our technology sales efforts	3
The financial benefit from our technology sales have been rather small	2
We have considered, but never previously progressed, any technology sales	1
Our company has never considered any technology sales as an exploitation option	0
Project Reviews	
We review all projects regularly to ensure that benefits outweigh the remaining costs	3
We expect to incorporate regular economic and technical reviews into our plans	2
We are reluctant to stop projects with poor prospects after investing large sums	1
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ANNEX II

POLICY RECOMMENDATIONS FOR THE STAGES OF THE CLUSTER LIFE CYCLE [73]

Early Stage Cluster Policy: Approach Towards Agglomeration Clusters

R1: Cluster creation requires formalization such as documents of initial concept and agreement between its members that define the cluster objectives (Memorandum of Understanding), its economical and geographical boundaries, and the level of cooperation/competition.

R2: Cluster needs should be identified considering the context, specificities of the territory and of the sectors. Evidence of need, demand and opportunity are required for each of the priority sectors using the following:

- Sector/cluster mapping studies involving consultation with industry and universities;
- Development of Strategy and Action Plans involving consultation with industry and universities;
- Boards/Steering Groups; and
- Participation in networking events.

R3: Identify and involve technological or industrial leading actors of the given sector / technology.

R4: Support innovation and technological development in growth subsectors emerging from traditional sectors and services and their overlaps.

R5: Involvement of SME support organizations is a key step to ensure the development of a relevant, innovative and competitive supply chain on the global market.

R6: Use “non technological collaboration” incentives to involve SMEs in order to overcome the barriers of competition that usually exist between them.

R7: Involve existing SME associations to ensure an efficient networking with small companies.

R8: Link cluster policies to other economic development policies / tools.

R9: Lobbying and creating dialogue between industry and government authorities, at regional, national and international levels.

[73] CLUNET - Cluster Network Project (2008), “Cluster Policy Guidelines Report”, mimeo (http://www.zab-brandenburg.de/files/documents/CLUNET_policy_Guidelines_080108.pdf).

R10: Relevance of existing and tested partnerships in order to enhance and develop clustering processes and thus to spread innovation.

R11: Clearly identify and promote potential financial funding sources.

R12: Anticipate financial needs as some sources may take several months to be obtained.

R13: Increaze transparency of the support for cluster participants.

Reinforcing Cluster Policies: Approach Towards Emerging/Developing Clusters

R14: Facilitate coherence between strategies and infrastructure that will foster knowledge sharing, innovation conditions and a higher competitiveness.

R15: Focus investment on support infrastructure that will enable a higher degree of networking between all research and technological stakeholders.

R16: Clusters have to provide strategic plans before asking for Ministry help or tendering a national / regional call for projects.

R17: Use a common branding and marketing strategy for the overall clusters.

R18: Provide information on economies of scale to stakeholders on communication matters (e.g. common participation in conferences).

R19: Attract FDI through common communication strategies.

R20: Use technology watch and trends to define clusters' unique selling points within the global market.

R21: Monitor evolution of the clusters' life cycle and foster collaboration between stakeholders accordingly.

R22: Technology transfer requires a broad set of activity from networking to financial support schemes in order to facilitate the development of knowledge-based activity.

Mature Cluster Policy

R23: Define within the contractual agreement a detailed action plan of cluster initiatives with objectives, expected impacts and a set of indicators.

R24: Negotiate the contractual agreement with one legitimate cluster lead organization.

R25: Obtain an official signature of the contractual agreement between the funding bodies and the cluster lead organization.

R26: Internationalization policy incorporates promotion of international linkages, sector focused marketing strategies, trade development, promotional activities and skills development.

R27: Involve various public bodies in a common internationalization strategy with centralized funding.

R28: Include strict guidelines on monitoring and evaluation requirements within the framework of the cluster policy.

R29: Monitor the performance of the cluster policy through regular policy evaluation cycles.

R30: Use data and indicators to ensure better governance of cluster initiatives within the cluster.