



The Innovation Competence Broker: Bridging firms and R&D institutions

**Edited by
the REBASING Partnership**

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Introduction

Everything must begin and everything has already begun.

E. Morin

Innovation policy has become one of the core actions in Europe, as an effective way to face increased competition and business maturity and exploit new opportunities in tough economic times.

Innovation does not come out of the blue, it is an interactive, collaborative process, involving private and public knowledge providers, firms and policy makers. The ability to develop, identify and select organisational models and technologies for successful innovation is one of the core competences that can ensure competitive advantage.

Within this perspective, which saw the development of Innovation chains particularly in Small and Medium Enterprises in an Open Innovation approach, the broker has proved to be an effective tool to support innovation in SMEs, where there is a stronger need to identify solutions but less access to Research and Development providers. The role of the broker is to initiate and foster cooperation between firms and R&D providers, through an understanding of the enterprise's needs and a mediation/translation action among the "languages" spoken by different stakeholders.

The aim of the Authors is to provide a detailed overview of Research-based competence broker activities and profile. The work stems from wider strategic needs for maximizing the impact and use of knowledge in the industrial system. The broker intervention process shows his/her role in helping a company to identify suitable innovation projects, leaving it up to the firm to implement them in cooperation with the R&D provider(s). In fact, the real added value brought by the broker lies in his/her ability to strategically manage his/her own network, constantly widening and enriching it in order to provide the best answer to companies' needs.

The methodology applied to identifying the process of intervention and broker competences is a mix of literature reviews, case studies, practice analysis and in-the-field observation and validation.

As a common method, European Union frameworks designed to secure mobility to the European labour market and transparency to EU citizens' qualifications were applied and integrated. Namely, the broker profile is described according to the European Credit System for Vocational Education and Training (ECVET) and the European Qualification Framework (EQF), in order to enhance profile transparency and ensure permeability of possible related qualifications.

This publication is divided into three main parts. The first shows the results of the literature reviews and practice analysis in order to define an overarching model for a research-based broker profile. Chapter 1 tells the story of a broker supporting innovation in Norway, his application and perspective. Chapter 2 provides an overview of the broker's key activities and the related process of intervention in companies. Chapter 3 proposes a literature review at international level, comparing the outcomes of six case studies in Italy, in order to define broker knowledge, skills and competences according to the European Qualification Framework. Chapter 4 analyses the broker's role in management of the innovation process and presents a relevant case study in Estonia.

The second part illustrates in Chapter 5 the outcomes of in-the-field observation and validation of the broker's profile in 3 countries (Italy, Germany and Switzerland), through the identification of Open Innovation networks and the implementation of Innovation audits in local companies, together with remarks about the broker's training. Chapter 6 presents the validated profile according to ECVET and EQF.

The third part comprises Appendices which gather the data analysed in Chapters 2 and 3, namely the main activities of the broker in 6 organizations in Northern Italy, and the competence identification of 6 brokers in Southern Italy.

This publication presents a contribution towards the development of organisational roles, such as that of the broker, in order to foster innovation in the European Union. It was designed and produced in the context of the Rebasing project of the Leonardo da Vinci - Lifelong Learning Programme, which aims at improving cooperation between knowledge providers and enterprises.

The REBASING partnership

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Research-based Competence Brokering in Norway: Bridging firms and R&D institutions

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In this chapter we will examine the historical roots and the theoretical foundation of the competence brokering instrument in Norway (Paragraph 1.2). Then we will take a closer look at the present operation of the instrument (Paragraph 1.3), and outline some of the results from completed projects (Paragraph 1.4). In the final section we will elaborate on challenges for this innovation instrument in the future (Paragraph 1.5).

1.1 Introduction

Research-based Competence Brokering has a long tradition in Norway. It involves a broker that assists small and medium sized enterprises (SMEs) in developing their own research and development projects. The enterprise is assisted by a researcher from an R&D institution when accomplishing the project. Competence Brokering (CB) was introduced as an innovation instrument in 2004, but the historical roots of such working method could be traced back to the mid-1990s. There are two goals for the instrument. The first is linking the SMEs needs to research opportunities. This is done by promoting greater focus on R&D activity in companies with little or no R&D experience, in order to increase their internal innovative capacity and thereby enhancing value creation and competitiveness. The second is to stimulate research institutes as partners to SMEs. This is done by strengthening the role of the research institutes as partners in collaboration with industry. Competence brokers should act as mediators for contribution to a heightened awareness of the possibilities and potential of the SMEs demand for research. Through organisation in regional coalitions, competence brokers or mediators should contribute to a heightened awareness of the possibilities and potential offered to the regional development by research.

1.2 The development of Competence Brokering in Norway

1.2.1 Norwegian innovation policy and Competence Brokering

Competence Brokering is one of several public instruments that have been developed in Norway in order to strengthen the links between firms and R&D institutions. It has been anticipated that this will increase firms' innovation capacity and their abilities to introduce new products and processes. These instruments form a pivotal part of the Norwegian innovation policy. Although innovation policy as a concept emerged in Norway early in the 1980s, the policy area itself is significantly older (Remøe et al., 2004). Both before and after the 1980s, innovation policy was integrated with various portions of a broader business policy, comprising industrial policy, research policy, education policy, regional policy. Innovation policy as an explicit area was long anchored to a type of technology-push policy that can be characterised as a "first-generation innovation policy" (op. cit., p. 30-31). The content and organisation of innovation policy has, however, changed substantially over the last few decades. The innovation policy that has gradually emerged, with its emphasis on cooperative networks and connections among political institutions, industry and commerce, and R&D, differs radically from the previous focus, where innovation and industrial development were seen as a direct result of scientific and technological research. However, linear models and technology-push perspectives continued to strongly influence the formulation of innovation policy in the early 1980s, despite formal recognition (as stated in various white papers) that innovation was the result of a dynamic interplay between separate, interacting factors and actors.

It was not until well into the 1990s that an approach grounded in innovation policy based on a system perspective on innovation and the perception that innovation is an interactive process, began to take shape (Lundvall, 1992). Initiatives that grew out of this knowledge, network- and system-based perspective have been characterised as "second generation innovation policy" (op. cit., p. 31). Such policy instruments, including competence brokering, have played a central role in Norwegian innovation policy over the last two decades (Jakobsen and Onsager, 2008).

Although there is still a significant amount of heterogeneity in the innovation policy instruments portfolio in Norway, we can differentiate between two main types of policy tools. Firstly, we have national innovation policy tools that by and large represent first-generation innovation policy. These tools are financed and operated at national level and are largely "equally independent" from any geographical context. These are mainly general policy tools that are primarily directed towards innovation in all firms and industries, although these also include occasional selective initiatives directed towards innovation in a specific industry. FORNY and SkatteFUNN are examples of this type of innovation instruments. Secondly, we find policy tools that are coordinated and primarily financed on a national level, but where the actual implementation is rooted in regional environments and institutions. Some of these initiatives are exclusively financed by national funds, while others have a

combination of national and regional co-financing. These policy tools mainly represent second-generation innovation policy, and they are more closely tailored to meet specific regional needs. Competence Brokering and the Arena programme (a cluster development programme) are examples of this type of instrument. There are also a few purely regional innovative policy instruments, where both funding and operations are limited to the regional level (Jakobsen and Onsager).

In Norway, Competence Brokering was introduced as an innovation programme in 2004. The double aim was originally to promote R&D in small and medium-sized enterprises with little or no experience with R&D, and to strengthen the research institutes as partners for innovation in private businesses. Emphasis was later put on the former goal of the programme. The competence broker's responsibility was to connect businesses to relevant R&D institutions. The historical roots of such working methods could be traced back to the old TEFT programme (Technology transfer from research institutions), introduced in 1994. The second version of the TEFT programme ended with the introduction of the Competence Brokering programme. Formally, Competence Brokering was organised as a sub-programme within MOBI (Mobilisation for R&D-related Innovation) in the Research Council of Norway. Evaluations on the Competence Brokering programme documented important results at firm level, and competence brokering became one of the most important innovation instruments in the new VRI programme (Virkemidler for regional FoU og innovasjon - Programme for Regional R&D and Innovation), introduced in 2007 (Jakobsen and Døving, 2006; Jakobsen and Stensheim, 2007). Three precursor innovation programmes, Value Creation 2010 (VS2010) and the Industry College Collaboration Scheme (ICC Competence Brokering), in addition to Competence Brokering, were merged into this new initiative. Thus, the VRI programme represents a continuation of working methods, networks and structures of former innovation programmes.

At present, the VRI programme consists of 15 regional initiatives, each with its own organisation, strategies and projects. The yearly budget for the VRI programme was approximately 10 million EUR in 2008. The programme is operated by the Research Council of Norway and is supported by the Ministry of Local Government and Regional Development. In addition to the national funding, there has to be a regional funding of a minimum of 50% of the total budget for a regional VRI initiative. This funding has primarily been provided by the County administration. Despite the fact that VRI includes several innovation instruments, Competence Brokering is by far the most important one. In total, nearly 1200 firms participated in the regional VRI initiatives in 2008, and more than 50% of these took part in competence brokering (Jakobsen et al., 2012).

1.2.2 The idea of the instrument

The theoretical foundation for Competence Brokering can be found within the innovation system approach. This approach was developed during the 1980s and 1990s (Lundvall, 1992; Edquist, 1997; Morgan, 1997; Cooke, 2004). It includes writings both on the National Innovation System (NIS) (Lundvall, 1992) and the Regional Innovation System (RIS) (Cooke, 1992). The latter is of particular interest.

The first explicit article on RIS was published by Cooke in 1992, while pioneer works by Asheim (1995) and Asheim and Isaksen (1997) elaborated upon RIS in a Norwegian context.

A common feature for studies both of NIS and RIS, using an innovation system approach, is an emphasis on learning and innovation through networking and on how public policy tools can stimulate such knowledge-based development (Asheim and Isaksen, 1997; Remøe, 2005). Innovation is appreciated as a complex, interactive process involving a number of interdependent organisations (such as firms, R&D institutions and public agencies) (Morgan, 1997; Cooke, 2004). In an innovation system there can be different types of system failures that reduce its ability to innovate. Edquist (2001) identifies four potential system failures: missing functions, missing organisations, missing adequate institutions and lack of interaction in the innovation system, especially between firms and R&D institutions.

According to Isaksen and Remøe (2001, p. 300), the concept of innovation system “...should be understood mainly as a political-economic concept, where the creation and development of innovation systems compromise negotiation and learning, including exerting power, influence and trust”. This puts the development and implementation of policy tools at the forefront of innovation system research. Lack of interaction between firms and the R&D sector has been identified as the main failure of the Norwegian system (Jakobsen and Onsager, 2008). Several innovation programmes have been launched since the late 1990s, emphasizing how the innovation capabilities of the economy can be strengthened by facilitating cooperation between firms and R&D institutions. The importance of the regional level, and RIS, in facilitating such cooperation, is partly based on the observation that knowledge spillovers, which are essential in processes of interactive innovation, tend to be spatially bounded and decrease with distance. It is also a fact that regions differ with respect to industrial specialisation, institutional architecture and patterns of innovation (Tödtling and Trippel, 2005). Hence innovation activity is a territorial phenomenon.

The link to ideas on the innovation system approach is explicit in both the Competence Brokering programme, its precursor (TEFT) and in the succeeding VRI program. Isaksen and Remøe (2001) sum up experiences from some of the early regional innovation policy initiatives in Norway, including TEFT. The rationale behind this policy was a rediscovery of the region as an important source of competitive advantages in a globalising economy. Some of the inspiration came from writings on the development of industrial districts and geographical clusters of small firms in the “Third Italy”. The need for proactive working methods in order to stimulate innovation in targeting groups of firms was also acknowledged. Further, the Competence Brokering programme shared this focus on development at the regional level. In the Competence Brokering programme it was stated that the programme “should stimulate cooperation between actors (county authorities, R&D institutions, the industry) at the regional level through a triple helix” (Research Council of Norway, 2004, p. 3, translated by the present authors). In the VRI programme this has been made even more explicit: “The VRI programme builds on a *system-oriented* perspective in which innovation is viewed as a collective, interactive process... The VRI programme is designed to promote knowledge development, innovation and

value creation through regional collaboration - particularly between companies and R&D institutions - and to encourage increased investment in R&D in and for the regions” (Research Council of Norway, 2007, pp. 2-4).

1.3 Implementing Competence Brokering in Norway

As we have seen, Competence Brokering has a long tradition in Norway. It is a well established instrument, and at present it is one of the main instruments in the VRI programme. *But how is the instrument operating?* In CB, a broker assists a firm in developing its own R&D project. The process is heavily dependent on the broker’s personal ability and established networks, so these activities are mostly conducted by R&D institutions that have previous experience with this innovation instrument. Working methods and routines from the Competence Brokering programme have been pursued in the VRI programme, but many of the principles were developed in the old TEFT programme, introduced in the mid-1990s (Jakobsen and Døving, 2006). However, it is not only about continuation of old practice. Some new brokers and institutions have been engaged in the VRI programme, which implies a certain diversification and new interpretation of established working methods. An institutional national learning arena for CB was not pursued with the introduction of VRI, and this has also led the way for more diverse working methods (Jakobsen et al., 2012).

Consequently, there are regional variations in the operation of Competence Brokering. In the following, we will use the working methods of the VRI project in the county of Hordaland (Western Norway), as an example. Roughly and stylistically speaking, the Competence Brokering process in this region can be divided into 10 stages. The process starts with planning a round of visits to interesting companies (1) (this number is the reference to the flow-sheet in Figure 1.1). As the brokering project is a part of VRI, and is financed partly by the Norwegian Research Council (NRC) and partly by the Hordaland County Council (HCC), the broker has to work in accordance with guidelines given by their owners. These guidelines are found in policy documents at HCC and NRC. These rules set some limits as to which companies are allowed to participate in the brokering programme. The limitations can be industry dependent or district dependent or both.

The CB process is pro-active, and the broker establishes contact with individual companies according to the proposed plan. The broker may also respond to an inquiry from individual enterprises, which know about the VRI programme and already have project ideas to discuss. The individual company projects that the broker helps to establish are financed either by Innovation Norway (IN) or HCC. IN have their own guidelines for financial support, and the companies have to comply with them to get support. The HCC have other priorities to give companies financial project support. The first step is therefore to clarify whether the company is entitled to support or whether it is falling outside of it due to central or regional priorities. The firm must be capable of financing approximately 25% of the project expenses by itself. The broker

gives the company a thorough survey concerning financial standards, structure and market prospects before visiting it.

The broker is now ready to visit the firm to try and clarify its needs (2). Companies meet many and complex challenges. Developing new products or services, or improving existing ones, developing new production methods or improving existing ones, establishing contacts with new customer groups or markets, including internationalisation, designing and developing the organisation of the company, remaining professionally up-to-date and establishing contacts and networks are all relevant topics. It is essential that the problems and projects that are discussed lie within the firm's strategy. Involving leaders of SMEs in strategic discussions is important in order to anchor the projects and give the right priority to the different problems that will possibly emerge. As the saying goes: "If you aim at nothing, you are sure to hit it": strategy is therefore quality guidance for getting the projects on track. This is also in accordance with the practical implementation of the TEFT programme of the 1990s.

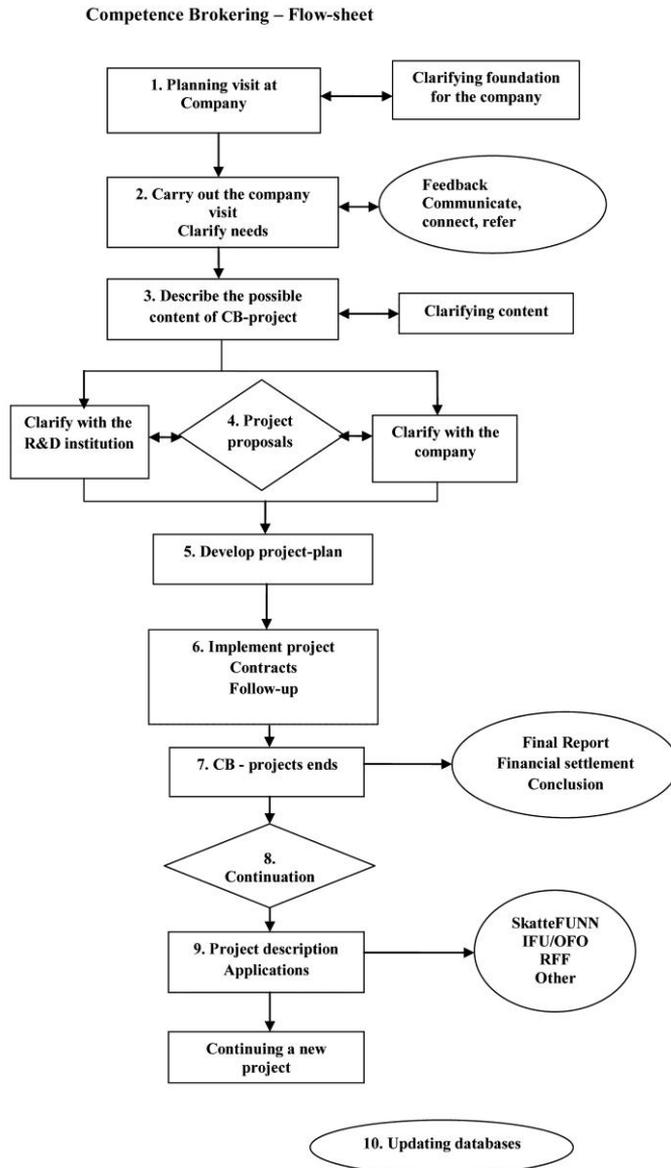
After the broker has tried, as thoroughly as possible, to clarify the actual project and the competencies required, he then engages in dialogue with providers of such expertise (3). This is done by consulting colleagues and relevant R&D institutes. R&D and business expertise suppliers are then related to see if they match each other's goals, and to make sure that they can communicate in a good way. Communication and personal relations are vital for a good result, and lack of trust can overturn a good project. Companies themselves can have a request for a specific expertise supplier, usually at the institutional level. This should be followed up by the broker.

Now the specific project is described in close collaboration with the company and through dialogue with the expertise provider (4). It is checked against those who may allocate money to clarify if the project definition and description of the expected end results meets the requirements for support.

The details of the project proposal must then be clarified with the R&D and business expertise suppliers, and a project plan is prepared (5). The next step is to implement the project and the contract is drawn up (6). There are usually one contract between the company and the financier (i.e. IN or HCC), and one contract between the company and the R&D provider. The normal contribution from the financing institution is 35 to 50% of the total project costs, or approximately € 10.000 to € 20.000 per project. Depending on the firms' contribution, a minimum of 10% of the total project costs has to be in cash, while the rest can be man hours or other expenses. The competence broker maintains contact with the company to see if progress is good, and that cooperation between the company and the R&D supplier is good. After the competence brokering project is completed, there will be a short final report with an accounting statement.

The financial settlement and the project are completed (7). The brokering project could also be considered as a pilot project that will be continued through a new project (8). This will then result in an application for project funding through SkatteFUNN, IRD / PRD, or other instruments in Innovation Norway, the Norwegian Research Council or the EU. The competence broker will assist the company in

finding suitable programmes for the application (9). All the brokering projects are documented in an appropriate form, and aggregated preferably in a database (10).



Developed from: D. Lothe, 2010

Figure 1.1 The competence brokering process

In general, it must be underlined that a competence brokering project is a fairly small project. It is directed towards the early phase of the innovation process and the intention is to increase a firm's ability to innovate. The content of a project can, for instance, be testing and documentation of a technology, incremental changes of a proven technology, market research for a new product, investigating the possibilities for larger research projects, developing the firm's network towards research institutions or competence upgrading.

In Hordaland, Competence Brokering is managed by the Centre of Innovation at Bergen University College in collaboration with UniMiljø at the University of Bergen. The team of brokers includes 6 people and they make up a working group to cover a range of skills and fields. Each broker makes up for 20% to 60% of his or her full-time engagement to cover the necessary fields and skills. The total workload for competence brokering in Hordaland equals about two man-years. The team has a coordinator who reports to the person in charge of the VRI project, which is managed by the Hordaland County. The brokering team has a goal to establish about 10 projects a year. To accomplish this goal, the team visits around 50 companies every year.

1.4 Results from Competence Brokering

As a well-established instrument, the evolution of Competence Brokering has been analysed in several ways in Norway. This has mainly resulted in independent evaluations from research institutions (process and results evaluations). There are, for instance, two evaluation reports dating back to the period when CB was a programme (Jakobsen and Døvig, 2006; Jakobsen and Stensheim, 2007), while there is a selection of reports from various regional VRI initiatives (for instance Garman Johnsen et al., 2010; Båtevik and Yttredal, 2010; Jakobsen et al., 2010). As mentioned earlier, Competence Brokering was included as one of the main instruments when the new VRI programme was launched in 2007. Based on findings from these evaluations, in the following section we will discuss some of the results that have been identified. The nagging question is, of course, to which extent competence brokering can be regarded as a successful innovation instrument.

In 2007, Jakobsen and Stensheim conducted a survey among firms that had participated in the Competence Brokering programme. The survey included responses from 68 firms, representing a response rate of 41%. In the survey firms were asked to rate the main results from participating in the programme. Table 1.1 shows that increased knowledge about the R&D institutions was regarded as the most important factor. Other important results were increased competence on product and process development and an improvement of the firms' network. They also found that the lesser R&D experience firms had, the more valuable was their participation in the programme.

Table 1.1 Results among firms that have participated in the 2007 Competence brokering programme¹

	Firms with some R&D experience (N=31) ²	Firms with little R&D experience (N=29/31) ³	All (N=60-62)
Increased knowledge about R&D institutions	2.81 (78 %)	3.00 (78 %)	2.91 (78 %)
Increased competence on product and process development	2.50 (59 %)	2.70 (67 %)	2.60 (63 %)
Improve the network of firms	2.55 (61 %)	2.42 (48 %)	2.48 (55 %)
Increased competence on project planning and management	2.31 (50 %)	2.47 (43 %)	2.39 (47 %)
Improved production process	2.03 (42 %)	2.28 (48 %)	2.15 (45 %)
Improved profitability	2.03 (39 %)	2.21 (38 %)	2.12 (38 %)
Improved organisation and leadership (management)	1.87 (27 %)	2.10 (38 %)	1.98 (32 %)
Cost reduction	1.68 (19 %)	1.97 (27 %)	1.82 (23 %)

¹ The alternatives are ranked based on an average score from 1 (not at all) to 4 (to a high extent), the percentages that reported 3 or 4 are presented in parentheses.

² Includes firms that have purchased R&D services over the last three years.

³ Includes firms that have not purchased R&D services over the last three years.

Source: Jakobsen and Stensheim, 2007.

In this survey they also asked firms in which geographical area they had established new R&D networks as a consequence of participating in the Competence Brokering programme. They found that firms have developed both their regional and national networks with R&D institutions (Table 1.2).

Table 1.2 Development of R&D network among firms participating in the 2007 Competence Brokering programme¹

	Firms with some R&D experience (N=30-32) ²	Firms with little R&D experience (N=30-31) ³	All (N=60-62)
The firm project has linked the firm with researchers and R&D networks in the <u>county</u>	2.44 (56 %)	2.68 (61 %)	2.56 (58 %)
The firm project has linked the firm with researchers and R&D networks <u>nationally</u>	2.48 (51 %)	2.32 (32 %)	2.41 (42 %)
The firm project has linked the firm with researchers and R&D networks <u>internationally</u>	1.80 (17 %)	1.60 (10 %)	1.70 (13 %)

¹ The alternatives are ranked based on an average score from 1 (not at all) to 4 (to a high extent), the percentages that reported 3 or 4 are presented in parentheses.

² Includes firms that have purchased R&D services over the last three years.

³ Includes firms that have not purchased R&D services over the last three years.

Source: Jakobsen and Stensheim, 2007.

Other findings from this survey were that most of the projects were conducted according to the plan (83% of participating firms), that a huge majority of the firms were satisfied with the work of the competence broker (85% of participating firms) and that nearly all of the firms reported that they were positive about using a researcher at an R&D institution in a future project (90% of participating firms).

Several evaluations have also been conducted on regional VRI initiatives where competence brokering is one of the main instruments. In VRI Agder (Southern Norway) a survey has been conducted among participating firms. The survey is reported in Garman Johnsen et al. (2010) and they evaluated VRI as fairly successful for participating firms. It has improved the network of firms, especially towards other local firms and towards the University in the region. It has also contributed towards the development of new and relevant knowledge among participating firms. However, there are less concrete innovation results (new products, new processes). Several of the projects have been continued after VRI.

A similar survey has been conducted among firms participating in VRI Møre (Western Norway). This survey is reported in Båtevik and Yttredal (2010) and they concluded that most firms have positive experience with competence brokering. They also found that participation has strengthened the network of firms, especially towards

other firms and institutions in the region (67% of the firms reported to a high or very high extent). In addition they found that participation has increased firms' knowledge about R&D institutions. Firms were also positive towards new projects that include links with R&D institutions.

In VRI Hordaland (Western Norway) an evaluation has been conducted including case studies of 10 firms that have been involved in competence brokering and 5 firms that have been involved in mobility, another VRI instrument. This evaluation is reported in Jakobsen et al. (2010). The main findings from their evaluation were that firms in general are fairly satisfied with their participation. Participation has given firms increased knowledge about how to use R&D institutions when innovating. It has also provided networks with researchers at R&D institutions or it has maintained existing networks. The authors also found that contributions from VRI were crucial for the implementation of the project, thus showing a high degree of additionality.

Summing up these reports, it seems that there is a high degree of consensus among the evaluators. Firms participating in CB are satisfied with this innovation instrument. Results from participation are linked to the early phase of the innovation process. *Thus, Competence Brokering increases the ability of firms to innovate* (new competence, new networks, facilitating for larger projects). Consequently, Competence Brokering in Norway can be evaluated as successful at firm level.

There are also some lessons to learn from these evaluations. It is important that competence brokers work in an R&D institution. They have to possess a combination of research and technology knowledge and business knowledge. They should also rely on a broad national and regional R&D network so that they know where to go for support and knowledge in helping SMEs to plan new business projects. Brokers should also have experience in project planning and implementation, so that they can act as project consultants for the SME. Another key competence for brokers is that they must have sufficient "soft skills". They have to communicate with the leaders of the SMEs, and obtain their trust so that they can act as counsellor and guide for the company in their development projects. It is also a fact that brokers must often work with technology-based SMEs. It is therefore essential that they can act as technology transfer mediators and that they know how to assure quality in the submitted projects. If possible, brokers should themselves also possess technology transfer process experience, so that they can give advice based on their own experience. This will help in establishing a trustworthy relationship between the broker and the company.

1.5 Challenges for Competence Brokering in the future

The long history of Competence Brokering in Norway has led to solid and well-established practice. A lot of SMEs have had the opportunity to build relations with R&D institutions and develop R&D projects based on their own challenges. It is, however, important to address the question about challenges and the future development of the CB practice as well. In this final section of the article, we identify some of these challenges and some reflections about the future.

The aim of Competence Brokering is to support firms with none or limited R&D experience. This has an obvious effect on the time frame of the brokering process and entails a greater degree of risk. However, the evaluation of competence broker projects seems to reveal that the majority of participating firms have either previous direct R&D experiences or they have been participating in similar projects. In other words, there is a discrepancy between the aim of the policy instrument and the actual practice. It is not surprising that brokers seek to reduce the risk of failures or lack of interests from firms with no previous R&D experience. At the same time, the result is that some firms strengthen their ties and network relations to R&D institutions, and some firms are not introduced to such networks. The degree of additionality in the outcome of competence brokering is thus a challenging question and needs to be clarified.

Another challenge in competence brokering is the degree of intra- vs. extra-regional links. Competence Brokering has mainly contributed towards links between firms and R&D institutions in the region. This addresses the challenges or danger of a lock-in. It is important to reflect on the possible consequences of such a situation in relation to the competitiveness and innovative content of R&D projects based on these relations. Establishing new extra-regional relations between industry and R&D institutions is a challenging task and it depends very much on the broker's capacity to identify specialised suppliers of R&D outside his/her own region.

Even if CB does have an impact for participating firms, we do not have any solid evidence on how CB contributes towards strengthening the role of R&D institutions as partners for the industry (goals of the institution, development of the regional system). How can we ensure that CB also strengthens the role of R&D institutions as partners for the industry? It can be difficult to balance a firm's goal with that of an institution within CB (and VRI), for instance when it comes to identifying which R&D institutions should be responsible for organising Competence Brokering and providing research competence in a firm's project.

These are some challenging questions for the further development of Competence Brokering and they should be addressed in a continuous effort to strengthen the practice as an important tool for the implementation of well-functioning regional innovation systems.

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2

The Technology Broker fostering innovation in SMEs: activities and intervention process

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Many studies emphasize the importance of technology brokers in fostering innovation in small and medium enterprises. Despite this acknowledged relevance, the literature does not supply a clear vision of the key activities that characterise the intervention of such intermediaries. Merging theoretical and empirical investigations, the chapter provides an overview of the brokers' activities, their overall process of intervention and, subsequently, the three main broker roles are identified.

Keywords: innovation management, broker, technology brokerage, small and medium enterprises (SMEs)

2.1 Introduction

The innovativeness of an enterprise has always been recognised as a valuable intangible asset, which plays a vital role in the transformation of business and society. Recent research has shown that knowledge supporting innovation does not circulate freely, especially among local actors (Bianconi and Barabási, 2001; Verspagen and Werker, 2004). In order to favour the dissemination and use of technological knowledge, a key role is played by individuals and organisations that operate for connecting companies with research institutions. The role of such intermediaries in the innovation process - often named brokers - has grown over the last two decades among both academics and policy-makers, as they could act as catalysts, accelerating the combination of complementary knowledge useful to solve innovation problems, by making the right connections and links with solvers and seekers (Sousa, 2008). In this way, brokers become a third party in charge of connecting, recombining and transferring knowledge to companies in order to facilitate innovation and increase collaborative advantage (Cillo, 2005; Giuliani, 2007; Morrison, 2008).

The relevance of the third parties in building interface and developing innovation capability is recognised as particularly crucial in small and medium enterprises (Hicks and Hedge, 2005; Kaufmann and Tödtling, 2002; Narula, 2004). Despite governments worldwide placing considerable emphasis on developing innovation capabilities in SMEs, the growing complex environment, the limited financial and human resources and the lack of scanning abilities make it difficult for these firms to find the competent partners that would provide them with complementary assets and resources (Narula, 2004; Nooteboom, 1994; MacGregor, 2004; McEvily and Zaheer, 1999).

Bridging organisations are a useful way to support SMEs in increasing a firm's potential to generate new ideas, identify new market opportunities and implement marketable innovations by leveraging on existing resources and capabilities. Moreover, they seem to be particularly relevant in reducing uncertainty in the early stages of innovation processes when there is a high risk of failure, which would preclude SMEs from innovating (Sapsed et al., 2007).

Despite the importance of the broker's role, most existing studies on innovation intermediaries focus on large organisations (Howells, 2006; Pittaway et al., 2004) and the issue of how bridging organisations could operate to support SMEs in their effort to increase their innovation capability is not yet adequately investigated (Klerkx and Leeuwis, 2008; Morgan and Crawford, 1996; Sapsed et al., 2007). Particularly, there is still a clear lack of understanding about the activities that bridging organisations should carry out to support innovation capabilities in these companies. In their review, Pittaway et al. (2004) concluded that the role of such third parties in innovation processes has been under-researched and, as Winch and Courtney (2007) stressed, "how innovation brokers operate" is still an open question. Some researchers (Pollard, 2006; Sapsed et al., 2007) claimed more empirical and theoretical knowledge to define the brokers' role in terms of their impact on the innovation process. In order to fill in this research gap, our research investigates the brokers' activities in supporting innovation capacity in SMEs, so as to answer the two research questions below.

RQ1: What activities could a broker carry out to support innovation capability in SMEs?

RQ: 2: What intervention process could the broker follow in supporting innovation capability in SMEs?

The remainder of this paper is structured as follows: Paragraph 2.2 describes the research methodology of both literature review and empirical analysis. Paragraph 2.3 summarizes the available literature on the main activities that a broker could carry out to support innovation capability in SMEs. Paragraph 2.4 empirically analyses the main activities characterising different bridging organisations operating in the Italian context and it discusses the relevant implications. Paragraph 2.5 illustrates conclusions and further research streams.

2.2 Research methodology

The research process was based on in-depth theoretical and empirical investigations of the broker's activities and his/her intervention process. Before illustrating methodologies used for implementation, we believe it useful to recognise the presence of different approaches adopted in studying this issue and to clarify what kind of broker is analysed in this paper. In more recent times indeed, with the consolidation of the world of information, there was a rapid spread of the notion of the so-called "knowledge broker", i.e. someone who knows how to access or acquire information and who provides a gateway to information resources. Winch and Courtney (2007) coined the term "innovation broker", defined as "an organisation acting as a member of a network of actors in an industrial sector that is focused neither on the organisation nor on the implementation of innovations, but on enabling other organisations to innovate". Such innovation broker is dedicated and independent, and mainly focuses on facilitating innovation by fulfilling the role of a mediator for SMEs (Batterink et al., 2010). Moreover, in the last few years, there has also been an increase in the number of studies that focus their attention on network orchestration (Smits and Kuhman, 2004; Van Lente et al., 2003; Winch and Courtney, 2007) and define a broker as the organisation able to span the structural holes (Burt, 1992; Walker et al., 1997) to improve information flows between actors.

Our investigation focused on the intermediary of the technology knowledge supporting innovation in SMEs. Network orchestration is fulfilled as a side rather than a core activity, as brokers operate within a network and the network management process corresponds to one of the innovation activities that a broker should manage (Klerkx and Leeuwis, 2008; Van Lente et al., 2003).

2.2.1 Literature review

In pursuit of the above mentioned research questions, we reviewed the literature on the brokers' activities that connected heterogeneous partners to favour innovation within companies. From this review, we developed a framework showing the groups of activities a broker could carry out in support of innovation in SMEs (Table 2.1), as described in the literature pertaining to this topic.

Given the extent of our research issue, the literature review adopted different perspectives that could be summarized in five main research streams coming from a number of disciplines: innovation, technology management, knowledge management, networking and small business management. As Howells emphasised, the multiplicity of terms employed by researchers to label such intermediaries – i.e. bridging organisations, third parties, innovation brokers, technology transfer brokers, boundary organisations - confirms the presence of different approaches in the study of these brokers and their activities (as analysed in the following section). Since our study included knowledge and technology brokerage in general, as well as the above mentioned five perspectives, in this paper we have used the term broker as an all-inclusive term.

In analysing literature, we adopted an approach that combined elements of systematic literature review (Denyer and Tranfield, 2008; Rousseau et al., 2008) with focus group meetings and the authors' previous knowledge of the brokerage and innovation management field developed over the past 15 years. Essentially, systematic reviews were formulated around the two research questions and the criteria for inclusion and exclusion of papers were clearly defined at the outset (Denyer and Tranfield, 2008). Keyword searches were used with predefined search strings (such as broker, bridging organisations, innovation intermediaries, innovation broker, brokerage, technology broker and knowledge broker) to identify articles published between 1990 and 2012 in specific management databases (such as Business Source Premier, Web of Knowledge, Emerald Insight, Scopus and ScienceDirect). In addition, a number of journals were chosen as they attracted a large number of papers in the field of innovation, very often addressing a broad range of managerial problems from an innovation perspective. These included Harvard Business Review, Technovation, R&D Management, International Journal of Technology Management, Academy of Management Review as well as other leading general management journals.

Considering the aims of our work, we found that the inclusion and exclusion criteria were developing and changing as we developed greater insights into both brokerage and innovative capacity, defined as the firm's ability to internally exploit knowledge. Innovative capacity comprises the process steps of transforming knowledge and converting it into new products or services (Khilji et al., 2006).

In the first instance, the authors individually and then collectively analysed these key themes leading to the definition of a group of activities characterising the technology management activities, assumed to be determinant of the innovation capacity. Then each broker's activity was analysed and classified in relation to the phases that characterised the technology management process. We focused on technology management as it was not just a specific technological innovation, but rather the capability to generate a stream of product, service and process changes that mattered for long-term firm performance (Rush et al., 2007). Innovation is recognised as a leading topic in technology management (Cetindamar et al., 2009) and the nature of the transfer process draws upon the in-depth understanding of the technology management process itself. Brokers should thus focus on closing the managerial gap through mechanisms which encourage the development of, or compensate for the lack of relevant technology management capabilities, especially in small and less experienced firms (Bessant and Rush, 1995).

Literature suggests several frameworks to support the understanding of technology management. In this study, our research framework was inspired by the Gregory et al. (1995) model, which was primarily identified because it was able to develop a comprehensive technology management process across the manufacturing business as it was consistent with other key studies (Bessant and Rush, 1995; Phaal et al., 1998; Rush et al., 2009) and recently validated by Cetindamar et al. (2009).

Following Gregory's model, five groups of technology management phases were investigated, namely Identification, Selection, Acquisition, Exploitation and Protection. As Bessant and Rush (1995) pointed out, each of these phases of the

research process should be further disaggregated in the constituent activities. The set of activities that will be initially investigated in each phase are (i) Identification: technology assessment, pre-selection framework, technology/market scanning, and information management; (ii) Selection: technology forecasting, benchmarking, decision criteria and process/monitoring, and improvement; (iii) Acquisition: internal R&D, licensing and joint ventures, organisational change, project management, and technology insertion; (iv) Exploitation: customer–supplier network, incremental development, product management and complementary assets and (v) Protection: identify options for protection, establish strategy and monitor effectiveness.

In carrying out the literature review, the above listed initial activities identified in the research process were revised in order to identify which activities described in the literature characterise the broker's intervention. These initial findings of the literature review were then discussed in some focus group meetings organised within an international research project. These focus group meetings involved a multidisciplinary group of academics and practitioners, operating in national and international contexts, and doing research in innovation management from different perspectives, including: Operations Management, Manufacturing Management, Service Management, Strategic Management, Industrial Engineering, Facilities Management, Public Sector Management, Psychology, Human Resources Management and Change Management. The discussion and feedback received from the focus groups helped further development of the research framework that is presented later in this paper.

We believe it useful to point out that the literature review we conducted, whilst not strictly following a systematic literature review approach, nonetheless provided a fit-for-purpose research protocol for our intended aim and supported our empirical investigation (Macpherson and Jones, 2010).

2.2.2 Empirical investigation: analysis of six case studies

To get a closer insight into brokers' activities in supporting the innovation process, a qualitative research was carried out based on case studies, to investigate a group of Italian intermediaries bridging research institutions with manufacturing SMEs. Following the writings of Voss et al. (2002) and Huberman and Miles (2002), we adopted the conceptual framework identified using literature and focus group meetings to guide the collection and the analysis of data, forcing us to carefully and selectively think about the variables to be included in the study (Huberman and Miles, 2002). This conceptual framework showed a view of the main steps and activities that were investigated by using multiple case studies. The data analysis was carried out using this framework, as described in Paragraph 3.3.

Following Wacker's (1998) work - also coherent with the study of many researchers as Eisenhardt, (1989) and Yin (1994) - we defined both the characteristics of the population from which the research sample was drawn. The specifications were as follows: (1) brokers active in the manufacturing industry and working in the North-East of Italy and (2) brokers promoting the development of innovation in manufacturing SMEs.

This choice was supported by two main factors. Firstly, on the one hand, as emphasised in scholarly literature, manufacturing SMEs are a key driver for the Italian economy and the development of innovation capacity is necessary to face the current competitive environment; on the other hand, there is evidence of a lack of resources and necessary knowledge for the adequate development of innovation capacity and for sustaining the innovation process of such organisations. Interactions between non-profit, science and profit sectors are distinctive in this geographical area; therefore, characteristics of brokers could be different and it should be interesting to investigate them empirically.

Secondly, over the last few years, in the North-East of Italy there has been a progressive increase in the number of brokers featuring activities and roles that are sometimes not very well defined (Bonesso and Comacchio, 2008). As a consequence, there is a need to define activities and ways to carry out any intervention in such organisations.

The selection was made by considering the significance of the brokers' experiences in supporting innovation processes in SMEs, i.e. broker institutions were selected that had been active on the market for at least 10 years, and with recognised successful experience. The selection of significant case studies was possible as all the institutions of the reference pool had already been studied and classified (Bonesso and Comacchio, 2008) and most of them had already worked with the authors of this paper; this made access to information easier for selecting significant firms and carrying out our research (Yin, 2003).

Data were collected while visiting institutions and interviewing people operating in a brokerage organisation, acting as brokers or managing brokering activities. During the empirical investigation, a rich amount of primary data was gathered and, throughout the research process, researchers deliberately sought confirmation leading to more reliable results. For each institution visited, semi-structured interviews were conducted. During the initial interviews, general questions were asked about the history, clients, structure, human resource education and managerial practices. Subsequently, interviews focused on brokering activities carried out in supporting the innovation capability of SMEs.

After the case study visit, collected information was transcribed and, whenever possible, additional data were added to it by using further evidence (like observation, documents and other material collected in the field), ideas and insights that arose during the visits. The brokerage institutions' (confidential and official) documents and interviews with external organisations were used to collect additional information and to better understand collected data.

As suggested by literature (Corbin and Strauss, 2008; Miles and Huberman, 1994), in order to interpret empirical evidence, data were grouped for each case into categories showing their relation with the phases of the innovation process, and we used them for within-case analysis and cross-case analysis (see Figure 2.3).

2.3 Literature background

As previously pointed out, this paper investigates the role of the broker as an actor supporting technology management in SMEs, assumed to be determinant of innovation capacity and, by way of synthesizing the various definition terms, in this study we use the term broker as “an organisation or body that acts as an agent in any aspect of the innovation process between two or more parties” (Howells, 2006). As previously pointed out, the literature was reviewed by considering the brokers’ support in the various activities that characterise technology management.

As far as the brokers’ process of intervention is concerned, literature identifies a number of activities. From the numerous definitions and studies on this issue, we extrapolated the key activities carried out by the brokers and, based on such activities, we compared the major studies on the subject. The following is a brief summary of the main research investigating brokers’ activities. Table 2.1 summarizes and compares these studies by quoting the words of the authors.

Howells (2006) provided the widest range of innovation intermediation activities (i.e. foresight and diagnostics; scanning and information processing; knowledge processing and combination/recombination; gatekeeping and brokering; testing and validation; accreditation; validation and regulation; protecting the results, commercialization and evaluation of outcomes). These activities have been discussed within the context of brokers’ functions and not of their network relationships. Simple triadic structures were mainly involved, whilst - where more complex multi-actor relationships in terms of intermediation were acknowledged - they were then largely ignored. The author emphasised the diversity of brokers’ roles from that of simply spreading and transferring existing innovation or knowledge at one extreme, to an initially much wider range of innovation intermediation functions than has been usually considered. Although organisations providing such intermediation functions tended to remain specialised around particular activities, the range of services being offered did appear to be increasing over time. In addition, organisations providing intermediation functions did not solely or even wholly restrict themselves to intermediary functions, but also covered more traditional contract research and technical services which involved no third-party type of collaboration (AIRTO, 2000).

Dobbins et al. (2009) described a broker as an individual, groups, organisations or countries being able to provide a link between research producers and end-users by developing a mutual understanding of goals and cultures. A broker collaborates with end users to identify issues and problems for which solutions are required, and facilitates the identification, access, assessment, interpretation and translation of research evidence into local policy and practice. The authors classified a broker’s activities into the following categories: initial and on-going needs assessments; scanning the horizon; knowledge management; network development, maintenance and facilitation; facilitation of individual capacity development in evidence-informed decision-making and facilitation of and support for organisational change. Dobbins et al. (2009) highlighted the need to include into the KB activity relationship development, on-going support, customised approaches and opportunities for

individual and organisational capacity development that are transversal to activities of the identification and selection phases.

Table 2.1 Key activities carried out by brokers

Phases	Activities	Howells, 2006	Dobbins et al., 2009	Hargadon and Sutton, 1997	Bessant and Rush, 1995	Van Lente et al., 2003	Batterink et al., 2010	Johnson, 2008
Identification (A1)	Assessment of company needs	Technology foresight and forecasting; Articulation of needs and requirements	Initial and ongoing needs assessments		Identification and selection of company's needs	Mobilization of relevant actors and support new	Identify innovation needs and articulate SMEs knowledge demands	
	Scanning scientific data base and patents	Scanning and information processing	Scanning the horizon	Access to technological information	Scanning and locating key sources of new knowledge	Exploration (achieve awareness)		
	Scanning and building networks	(implicit)	Network development, maintenance and facilitation		Building linkages with the external knowledge providers		Setting up partnerships with complementary actors and manage the inter-organisational cooperation	Provides template and resources to manage collaboration
	Scanning modalities to found research	Finding potential capital funding and organising funding or offerings			Scanning modalities for financial support			Enables the distribution of funding
Selection (A2)	Technology forecasting	Scanning and technology intelligence		Identify and store potential technological solutions	Articulation and selection of technology options	Stabilize (reflect on new goals) and identify technologies, niches and lock-in dangers	Orchestrate network composition and take the lead in setting up coordination mechanisms	
	Benchmarking and decision criteria	Scoping and filtering	Facilitation of individual capacity development in evidence informed decision making		Selection of appropriate options			Provides technology and knowledge transfer mechanisms by centrally managing connections in the distributed innovation
	Linking R&D and basic sciences	Combine knowledge of two or more partners; generate and recombine of knowledge			Communication and implementation	Identification of major trends		Ensure a repository of technological knowledge sources and expertise within the regional S&T infrastructure

Phases	Activities	Howells, 2006	Dobbins et al., 2009	Hargadon and Sutton, 1997	Bessant and Rush, 1995	Van Lente et al., 2003	Batterink et al., 2010	Johnson, 2008	
Acquisition (A3)	Research & Development	Negotiation and deal making and finalizing the contract	Translation, processing, generation, combination and exchange of knowledge	Bring technological solutions into the organisational memory	Managing external resources to support internal R&D	Embedding (standards; alignment; enrolment; interrelatedness creative destruction and construction)			
	Organisational learning and change		Facilitation and support for organisational change		Training and skill development and Organisational development	Identify major trends; awareness		Ensures mechanisms to ameliorate conflict and facilitate effective collaboration	
	Project management	Testing, diagnostics, analysis and inspection; Prototyping and pilot Facilities; Scale-up; Validation; Training			Project management				
	Technology insertion	Specification setter or providing standards advice; Formal standards setting and Verification (c) Voluntary and de facto standards setter							
Exploitation (A4)	Incremental development and product management	Regulation; Self-regulation; Informal regulation and arbitration		Retrieve old technological solutions from memory to fit the new combinations	Development and implementation of business and innovation strategies				
	Sales	Marketing, support and planning; Sales network and Selling							
	Funding	Finding potential capital funding and organising funding or offerings							
Protection (A5)	Identify options for protection	Intellectual property rights advice; IP management for clients							

Hargadon and Sutton (1997) described the leading product design firm, IDEO, which blends network and organisational memory perspectives in a technology

brokering model explaining how an organisation develops innovative products. IDEO acts as a repository of ideas, knowledge and resources that can be repeatedly recombined for brokerage. As a consequence, a technology broker is described as an organisation able to introduce existing technological solutions belonging to various industries, where they are not known. In this process, the broker creates new products that are original combinations of existing knowledge from disparate industries. The bridging organisation does not seek to provide advice on business – which is the role of the panel experts-or to analyse the industry – which is the role of the academic researchers, but rather enacts its role in scanning and searching for opportunities for brokerage, storing the information and necessary contacts affecting this process. It is important to specify that the role of the bridging organisation entails more than just transporting ideas between previously unconnected industries; it also means transforming, sometimes radically, those ideas in order to fit new environments and new combinations. Brokers, as agents, facilitate the process of knowledge and technology transfer “across people, organisations and industries”.

Bessant and Rush (1995) examined the interactive nature of the transfer process, reviewed some of the policy mechanisms which enabled it to proceed effectively. In particular, they looked at the role that can be played by consultants as an integral part of policies aimed at stimulating the diffusion of industrial best practices. They indicated the type of bridging activities which might be performed by such consultants - thus helping define and articulate the needs of the client with reference to innovation - and they provided a wide range of functions that covered all intermediary roles of consultants, and not just those related to innovation, i.e. articulation and selection of technology options; scanning and locating new sources of knowledge; building links with external knowledge providers; development and implementation of business and innovation strategies. Over time, this process can be seen as first substituting or compensating for a lack of and then development of internal capability. They also highlighted the more interactive and diagnostic role of intermediaries.

Van Lente et al. (2003) introduced the notion of “systemic intermediaries” in order to highlight the emergence of a new type of intermediary organisation that seeks to function at the system or network level, in contrast to traditional intermediary organisations that mainly operated bilaterally. Van Lente et al. (2003) described such “systemic intermediaries” as key actors for sustainable development – which required the coordinated effort of industry, policy makers, research institutes and others – and they identified four groups of activities characterising systematic intermediaries, i.e. exploitation, trade-off, embedding and stabilisation.

Batterink et al. (2010) investigated brokers as network orchestrators, and this fell under the school of studies on network brokers working inside innovation networks of the agro-food sector. The authors wrote that an innovation broker may have great added value for innovation networks with divergent organisations and they identified three network orchestration functions: innovation initiation, network composition and innovation process management. They investigated how innovation brokers successfully initiated and orchestrated innovation in SMEs and they identified a group of best practices of innovation brokers for the network orchestration processes.

Innovation brokers supported SMEs in identifying their innovation needs, articulating their knowledge demands, setting up partnerships and managing the inter-organisational cooperation processes. In order to orchestrate innovation initiation, brokers should be embedded in the social and business network of local SMEs, take the lead in handling conflicts between the network members, focus on enhancing transparency in the innovation network and focus on facilitating interaction between the network members.

Johnson (2008) showed that intermediaries exist to provide specific resources and to play specific roles that individual triple helix members (Etzkowitz, 2003) either could not provide due to a lack of the necessary resource(s), or were unwilling to provide because of the negative economic costs associated with obtaining and deploying the necessary resource(s). Because of the key role played by innovation brokers in the innovation process, they can play an important and distinctive role in innovation networks, in both small and large firms, with lower potential transaction costs within the network, high focus on collaboration and facilitation in the development of a technology network.

2.3.1 Conclusion of the literature review

The literature review highlighted a number of studies on brokers, a lot of terminological redundancy, different approaches and level of details and sometimes confusion in the description of activities. The use of the Gregory framework helped the first phase of analysis and synthesis of studies on the topic. During the analysis phase, the activities suggested by Gregory (listed in Subparagraph 2.2.1) were adequately modified as to summarize activities involved in studies on brokers.

The identified framework enabled us to compare the main studies on the topic in question and to highlight the four basic functions that pertain to the broker's activities:

1. *identify the firm's needs and corresponding demands in terms of innovation* (assessment of the firm's needs, scanning scientific databases and patents);
2. *network formation*: facilitation of links between the relevant actors (scanning and building of networks);
3. *selection of innovation*: technology forecasting, benchmarking and decision criteria, linking R&D and basic sciences;
4. *support to the innovation process management*: enhancing alignment and learning by the actors, which involves facilitating learning and cooperation in the innovation process.

Table 2.1 shows the resulting summary of activities discussed during the latest focus group meetings (see Paragraph 2.2). Such meetings led to two main changes in the layout that the literature analysis had produced.

First of all, the multi-dimensional nature of technology transfer suggests that activities to encourage and enable it will need to be wide-ranging and can be divided into at least two major groups. The first deals with the distinction between back-office activities and front-office activities. Initially, brokers should carry out a set of back

office activities in order to build a network, analyse ways to fund research, understand emerging technologies and trends. Such activities are not clearly expressed in the initial framework. However, the research group’s observations during focus groups showed the importance of the activities done prior to meetings with the firms and the research institutes for the purpose of collecting information - on firms, research institutes, resources and available knowledge - and building collaborative relationships that are essential to providing an intermediation service. Only after collecting a certain number of information on the relevant firms and available innovation patterns, the broker will be able to develop the front-office activities.

The second change has to do with the formalisation of a close loop cycle of the broker’s activities. Technology transfer is not an instantaneous event, but a time-based process involving several stages, as part of the informal knowledge derived from experience with particular activities (Bessant and Rush, 1995). On the one hand, front-office activities enable people to support companies during the processes of identification, selection, acquisition, exploitation and protection; on the other hand, they allow brokers to increase their knowledge and network of relations (Figure 2.1).

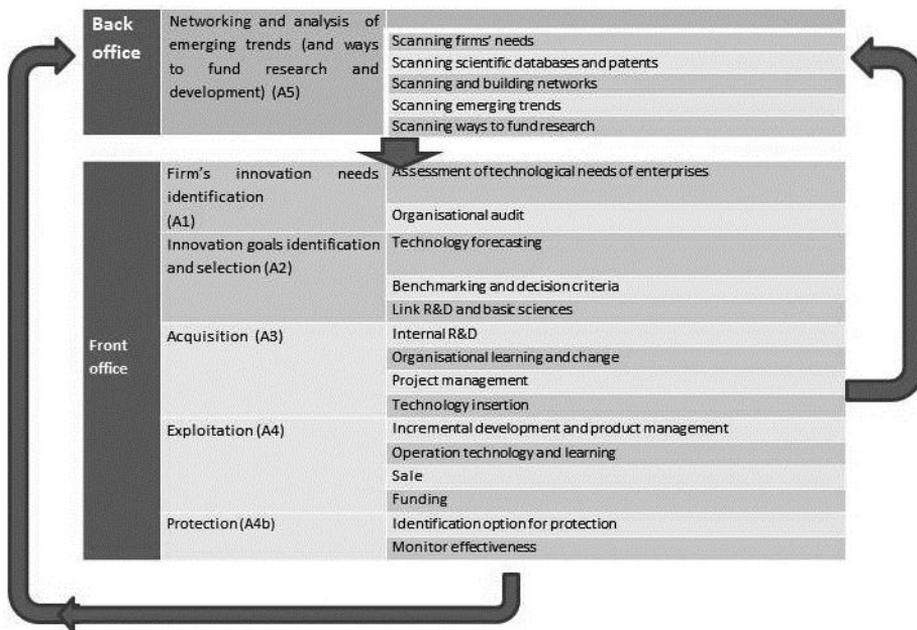


Figure 2.1 The close loop cycle of the broker’s activities

The framework thus obtained is divided into six main broker intervention phases, each with a group of activities, as described below.

Phase 1: Gathering preliminary information and networking in the back office to create the conditions preliminary to service brokerage in SMEs. This phase includes the following activities: scanning the needs of companies belonging to a specific industry or geographical area, scanning scientific databases, patents, emerging trends, ways to fund research, to gather information and knowledge to supply brokerage services to SMEs. In doing this, brokers create or enlarge networks with companies and research institutions that could be involved in the subsequent phases.

Phase 2: Firm's innovation needs identification. The evaluation of the technological aspects should be accompanied by a parallel evaluation of organisational aspects which are just as important, and often overlooked, especially in smaller companies. In this phase, brokers should support firms in the recognition of requirements for organisational and technological innovation through a systematic and regular audit of firms' competences and structures and comparison of those which it needs to develop or acquire in order to support its competitiveness.

Phase 3: Innovation goals identification and selection. Each firm should have a technology strategy and be able to plan its development. In the light of the results of previous phases, brokers should support SMEs to identify innovation goals and to explore the range of technological options available and search widely for these so as to get a good fit with their needs. There may be several competing solutions to reach innovation, such as different machines, different technologies, different suppliers, etc. In this phase, companies should carry out comparisons between all available options, which can be achieved through some form of benchmarking and formalisation of an application linking R&D and basic sciences.

Phase 4: Acquisition of technology, either through direct purchase or via some forms of license, collaboration, alliance, etc. This is likely to involve extensive negotiations around price, specification, transfer of knowledge, property rights, etc. In this phase, companies should carry out technological implementation within their organisation that may involve extensive project planning and management activities and require configuration of both technology and organisation to get a good and workable fit.

Phase 5: Exploitation. Brokers could support firms in implementing technological operations and learning how to best use it; over time this may involve extensive learning; the use of competences is very much the product of this last stage of accumulation and incremental development, and much of what is represented by technological competence is highly firm-specific and often tacit in form.

Phase 6: Protection. Brokers should support SMEs in the identification of options for protection, and establish a strategy for monitoring the effectiveness of the project.

The framework presents six separate phases, i.e. networking and analysis, firm's innovation needs identification, identification and selection of innovation goals, acquisition, exploration and protection. As Walsh and Ungson (1991) recognised, as these phases are part of an on-going process, it is difficult to design a static picture. It is important to emphasize that we use this framework because it fits our data reasonably well and provides a simple and analytically useful way of summarising these data. Nonetheless, the process was not always so neatly linear as the model implied and the steps could not always be clearly distinguished.

In the following paragraph, our analysis is focused on the broker's activities carried out by a group of heterogeneous brokerage institutions operating in the Italian context.

2.4 Empirical investigation of six case studies

A recent research carried out by Bonesso and Comacchio (2008) highlighted a wide range of organisations that carried out intermediary activities in the Italian context, such as research institutions, industry trade associations, professional associates, consultants, local chambers of commerce and various governmental agencies. To investigate the different types of intermediaries, from the broad range of organisations investigated by Bonesso and Comacchio (2008), we selected six case studies located in the North-East of Italy and operating into a wider structured organisation, namely the Bruno Kessler Foundation, Trieste Science Park, Treviso Tecnologia, the Galileo Science and Technology Park, the University of Padua and a local Employers' Association located in Belluno.

In Figure 2.2, a concise graphic representation is given of the six broker teams investigated (see the light grey area). Each one works within a larger organisation that is responsible for its genesis and that critically influences its relationship with small and medium-sized enterprises. The figure provides information on the mix of relationships of the brokers' team with SMEs, the home institution and research institutes with whom the home institution cooperates to give SMEs some support (in the picture the research institutes are identified with dashed circles in the home institution or on its left).

For each case study organisation, the broker's intervention process and the main activities that such a process features are described in Appendix A and the activities are summarized in Figure 2.3.

By analysing the six case studies, we get a clear picture of the brokers' activities and process of intervention. The proposed framework (Figure 2.3) hence allows us to summarize not only the activities carried out, but also the level of depth in the brokers' intervention.

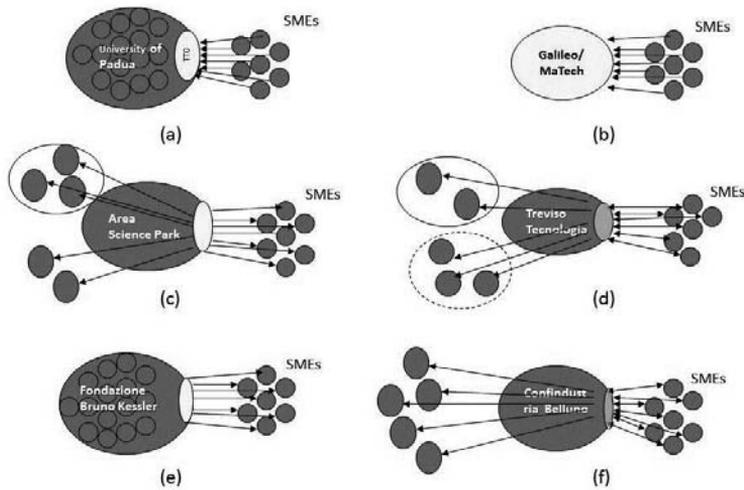


Figure 2.2 Relationship between the brokers, the home institution and SMEs [Legend: the light grey area indicates the position and size of the brokers with respect to the home institution]

		Key Broker's activities		Area Science Park	Fondazione Bruno Kessler	Treviso Tecnologia	MaTech	Industrial enterpr. association BL	Technology Transfer Office
Back office	Gathering information and networking	Scanning scientific databases and patents							
		Scanning and building networks							
		Scanning emerging trends							
		Scanning ways to fund research							
Front office	Firm's innovation needs identification (A1)	Assessment of technological needs of enterprises							
		Organisational audit							
		Innovation goals identification and selection (A2)	Technology forecasting						
	Acquisition and implementation (A3)	Benchmarking and decision criteria							
		Link R&D and basic sciences							
		Internal R&D	Organisational learning and change						
			Project management						
	Technology insertion								
	Exploitation (A4)	Incremental development and product management							
		Operation technology and learning							
		Sale							
		Funding							
	Protection (A5)	Identification option for protection							
Establish strategy									
Monitor effectiveness									

Figure 2.3 Brokers' activities in the six case studies [Legend: the black box indicates full presence, the hatched box indicates partial presence]

2.5 Discussion

In order to answer the first research question, “What activities could a broker carry out to support innovation capability in SMEs?” the analysed cases highlight that brokers could fulfil many heterogeneous activities. These activities could be grouped using the framework identified with the theoretical investigation.

As Figure 2.3 shows, most of the brokers completed the same activities in the back office, as they needed to collect, store and filter information on technology, firms’ needs, innovation trends, funds and networks. As a result, brokers could store a varied set of information and, subsequently using this information, they can act as a link that passes on information to a cluster of people they do not belong to.

The main differences are in the activities they carried out in the front office. Either directly or indirectly, the first three institutions (Area Science Park, Fondazione Bruno Kessler and Treviso Tecnologia) offer a wide support in the technology management process; MaTech supports the analysis and the selection of the material able to answer to the specific firm’s needs; the last two institutions (the TTO of the University of Padua, the Employers’ Association of Belluno) support the initial analysis of the company’s needs just to identify the research institution being able to answer the firm’s needs.

We believe it useful to point out that the identified activities give an overall view of all possible broker interventions, these activities could be useful to identify possible different broker roles, but they do not represent a prescribed list of actions.

In order to answer the second research question, “What intervention process could the broker follow in supporting innovation capability in SMEs?” empirical investigation provides insight into how brokers bridge the technical distance between parties and support innovation capability, which is useful to identify a comprehensive protocol of intervention. Such an intervention process constitutes a mix of non-linear relations, with some sequential macro-activities which may be positioned on three different levels and be preceded by a meta-level called back-office (Figure 2.4).

At the back-office level, the broker collects information on innovative solutions and emerging trends characterising one or more business sectors, gathers information on firms and research institutes and, in some cases, manages external communication activities for the purpose of disseminating information on the type of service that is being offered. After that (Level 1), contact with the small enterprise further develops from the targeted activity that the broker performed as he/she directly contacts the company and either offers auditing or supporting activities in technology management (company pull), or intervenes upon request of the company itself (company push) which is seeking an intermediary to find a solution to a specific problem that it cannot solve on its own due to a lack of sufficient internal competences. The broker’s offer or the company’s request are followed by a meeting between the broker and the company, which usually takes place at the company’s quarters, in order to collect preliminary information that could be useful to understand the actual needs of the company. This first-level activity of the broker aims at supporting the *networking capability* of SMEs so as to build the necessary stable networks that will help them

ensure success in innovation development (Gruenberg-Bochard and Kreis-Hoyer, 2009).

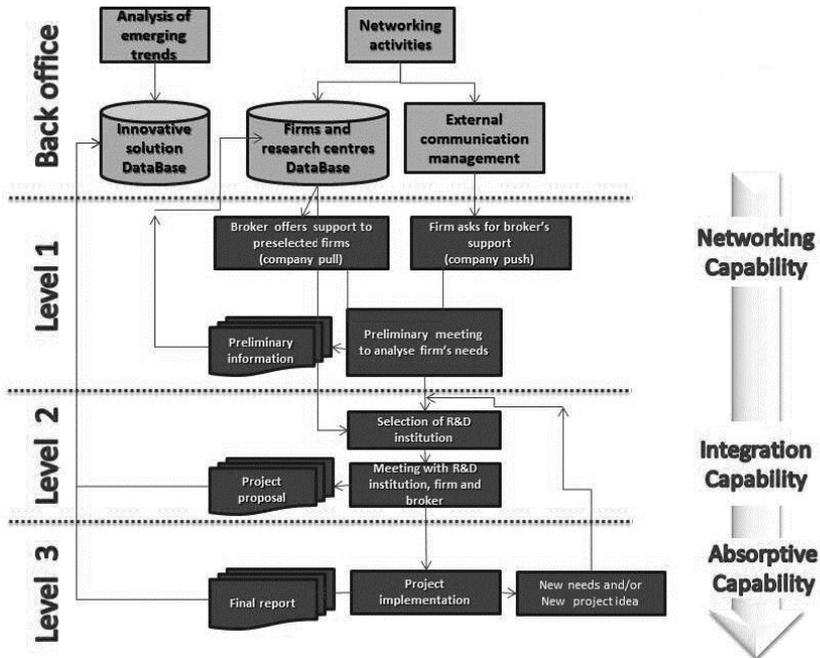


Figure 2.4 Intervention process

Later on (Level 2), based on information gathered during the back-office phase and the first-level analysis, the broker can identify the right research institute or group that should help meet the firm's needs and, within a few weeks, he/she can organise a meeting between the firm's staff and the researchers. If collaboration opportunities between the firm and the research institute do ensue, the broker intervenes by supporting the development of the *integration capability* of the firm with the research institute. The broker normally schedules and participates in an initial meeting between the firm and the research institute in order to facilitate communication, the definition of an initial project proposal and the integration of the firm with the research institute. The broker's integration role is especially important during this phase because SMEs' staff are not used to feeling included in an "over the company" dimension, i.e. being connected with research institutes such as universities, which are perceived as distant and also cut off from the "concrete" problems that small enterprises face. There are often language and communication barriers as well, both in the strict meaning and with respect to the goals being shared.

In this scenario, on the one hand, the broker supports the implementation of a network and the exchange of know-how promoting the development of new ideas (First level: support to relational capabilities) and, on the other hand, he/she favours SMEs in their internal and external integration process which is an essential step in choosing the ideas to be developed and in formalising the project idea (Mortara, 2007).

In some instances, the broker's intervention ends with the definition of such a proposal (see TTO and the Employers' Association of Belluno). In other instances, the broker's support even develops into a further level (Level 3); this is the case when the company accepts the proposal and a project is started: the broker continues with his support work by promoting the development of *absorptive capacity*, which scholarly literature recognizes as a key dimension of innovation capability (Cohen and Levinthal, 1990). Sometimes in this phase, the parties define some aspects connected with the management of the development projects by making reference to the resource planning and coordination activities and to the activities needed to turn preliminary concepts into industrialised products, i.e. Project Management, which sometimes feature the broker as a central component.

Besides providing support to the development of a firm's innovation capability, all of the broker's activities raise the formal and informal knowledge level of the broker, thus feeding what has been called a "double loop cycle" and promoting the broker's future activities.

During the analysis of the case studies, three more empirical proofs surfaced: the affiliation influence, the different approach of brokers belonging to the university and the importance of local institutions.

As Gould and Fernandez (1989) highlighted, a broker's behaviour is influenced by his/her proximity to institutions and, considering this proximity, they identified five different types of brokers, i.e. a) coordinator: enhances interaction between members of the group he belongs to; b) gatekeeper: absorbs knowledge from a group and passes his to the group he belongs to; c) representative: spreads knowledge of his own group to another group; d) cosmopolitan (itinerant); mediates as an outsider between members of the same group; e) liaison: as an outsider enhances interaction between different groups. While defining this distinction, the authors focused their attention only on the first levels of the broker's intervention, neglecting the activities that the broker could manage to support the acquisition and implementation of knowledge in technology management. Our empirical analysis highlights the high impact of brokers' affiliation, both in interaction management activities and in activities carried out during the entire intervention process. Brokers who work for organisations with internal research institutes or with consolidated partnerships tend to offer their support all through the technology management process. In fact, on the one hand, they possess the competences and can use the internal human resources needed to offer support all through the technology management process and, on the other hand, the broker's intermediation enables the start-up of projects that the organisation the broker belongs to has an interest in.

The TTO of the University of Padua is an exception: it offers assistance only in the management of the first contact. In fact, as literature underlines, universities play

a crucial role in increasingly knowledge-based societies (Etzkowitz and Leydesdorff, 2000) and in supporting innovation in profit organisations. However, their mission is not to transfer knowledge to profit organisations and, despite recent national and international research policy pressures, their focus is still mainly on scientific research (Van der Meulen and Rip, 1998). They usually transfer knowledge via the publication of research results, and only recently they have created technology transfer offices (Drejer and Holst Jørgensen, 2005). Consequently, if, on the one hand, they can function as a neutral and trustworthy partner to profit organisations (Boulding et al., 1997; Winch and Courtney, 2007), on the other hand, their pull approach on SMEs' demand should be integrated with the activities of the brokers who are at the service of SMEs to maximise their effectiveness.

Local institutions supply complementary services to universities that should complete the offer to SMEs. For instance, the Employers' Association of Belluno provides support services to SMEs in the local area. As intermediaries, local institutions facilitate the acquisition of competitive capabilities by compiling and disseminating knowledge and by reducing search costs (McEvily and Zaheer, 1999). As non-profit actors, they provide cognitive support (Aldrich and Fiol, 1994), especially when novelty is high, in addition to a handful of big profit organisations which know about accepted rules and standards. The main problem is the poor collaboration, careful planning and coordination with universities and other research institutions. Therefore, our investigations stress the importance of a careful management of integration between organisations "dedicated to research" with those that are "dedicated to SMEs". The connection should be established in the mutual interest of the parties involved, following Howells's definition (2006), i.e. bridging organisations connecting heterogeneous partners in a prosperous way for *all parties*.

2.6 Conclusion

The research identifies the key activities that a broker could carry out to foster innovation in SMEs and to propose a wide intervention process that could be put in place while choosing different levels of intervention. It means brokers can operate at different levels (Gould and Fernandez, 1989; Howells, 2006), all equally effective, and related to different missions of the organisations they belong to. As a consequence, it is worth underlining that our research does not identify a prescriptive list of activities that brokers should carry out. The empirical analysis of the brokers' activities and of the brokers' levels of intervention highlights the presence of three main broker roles that we could call *networking role*, *integration role* and *absorptive role*. These three roles are related to the three key dimensions of innovation capability: networking capability, absorption capability and integration capability.

According to literature, the ability of a firm to generate and access external ideas is dependent on its *networking capability*, i.e. how firms are able to create new networks with customers, suppliers or other partners (Hii and Neely, 2000; Pittaway et al., 2004). The capability to manage effectively local, national and international networks has an unquestioned positive relation with innovativeness (Eraydin and

Armatli-Köroğlu, 2005; Mort and Weerawardena, 2006; Ritter and Gemünden, 2003). Networking brokers could play a key role in supporting the development of this capability as they drive enterprises in learning about and understanding their position in the business network, knowing innovative solutions and perceiving the advantages of possible changes (Birkinshaw et al., 2006). The support to the development of relational capabilities is known to be especially important in small enterprises, which are commonly at the periphery of production systems and networks, and they have encountered difficulties in gaining advantage through networking (Tödtling et al., 2009). In these companies the horizon is often limited to upstream and downstream tangles that they have direct relations with, but they lack an overall view. A limited view may partly give rise to hypotheses that cannot be put in concrete form, but a slightly wider check, encouraged by a broker, could open up interesting perspectives, especially for small enterprises. Their typical organisational culture must be forced to look around, beyond their experiences, self-assessments, traditional experimented supply chains and hesitations towards institutional systems, such as universities and territorial institutions, in order to overcome bias and traditional difficulties that are often connected with mere language facts that a broker can indeed decode and interpret.

The relationship system that is activated within a network runs the risk of not becoming a real innovation enabler, if it does not lead to learning forms and to the internalization of knowledge. This ability to give value to the knowledge flows that come from external relationships is generally referred to as absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002). Absorptive capacity is commonly used to describe the ability of an enterprise to recognise the value of new external knowledge, to assimilate it and to apply it to commercial ends (Branzei and Vertinsky, 2006). The concept of absorptive capacity implies that the acquired (former) knowledge enables to recognise new knowledge, to assimilate it and to use it. Vinding (2006) underlines “the fact that absorptive capacity is dependent on individuals working in the organisation, especially people located at the interface of either the firm or its environment or at the interface between subunits within the firm. These gatekeepers are essential to reduce the mismatch in language and cognitive orientation between two systems and is especially important in development projects” (Vinding, 2006).

The two dimensions of networking and absorptive capacity are the most studied ones in scholarly literature as determinants of innovation capability, but they do not exhaust the subject, even if they explain a large part of it. Our empirical investigation points out the broker’s ability to support the *integration* of external knowledge with internal innovation needs to be taken into consideration, connecting the evolution of technology, which is basically external, especially in SMEs, with internal learning (Bergh and Lim, 2008). Knowledge-related asymmetries, or even just their hypotheses, often create attitudes and preconceived ideas that logically hamper the development of knowledge sharing, especially when knowledge – whether rightly or not – is considered as a set of distinctive, proprietary and competitive elements (Huysman and De Wit, 2003). An integrative mediation is then necessary in order to reduce the cognitive distance from technology (Branzei and Vertinsky, 2006) between

firms and external sources, and to hence lower the barriers that stop access to and interpretation of external knowledge. This is in fact an important dimension of the broker's intervention, as a gatekeeper of languages and knowledge. In other words, new ideas – or products – mirror existing knowledge (within an enterprise), although it is recombined in new and distinctive forms even through access to external knowledge which depends on the enterprise's ability to interact with such agents, with processes that are fed through the on-going activation of retroaction mechanisms, both between individuals within the enterprise (i.e. R&D and marketing departments) and between the latter and the other external actors, by means of mediations often necessary in SMEs (Lundvall, 1993).

Research limitations and the need for future research. The empirical investigation identifies six main factors influencing the broker's activities, i.e. individual affiliation, kind of partner, mission, age, gender, education, work experience, financial backer and industry. In the previous paragraph, we provided an insight on individual affiliation, but we did not investigate the impact of other factors. Further research should investigate these issues.

Finally, the empirical analysis shows that the intervention of brokers is acknowledged as an important support for SME innovation; however, we do not measure the effectiveness of brokerage activities. The level of brokerage, what exactly is being brokered, is not measured either, despite the recognised importance of the topic (Burt, 2005), as it was not the aim of this research. Further research should be necessary to investigate the relationship between brokers' activities and achieved performance.

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The role of intermediaries sustaining innovation processes in SMEs: the competences of the technological broker

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The aim of this chapter is to analyze the role played by technological brokers in sustaining innovation processes by acting as a bridging point between firms and knowledge provider centres. A methodological proposal will be made based on a competence approach theory to map the competence profile of a technological broker. The methodology seeks to test a set of competences a knowledge broker should possess in order to improve the level of innovativeness in a specific geographical context. Competence mapping will be performed through a set of explorative case studies.

3.1 Introduction

As literature highlights, collaboration and partnership between small and medium-sized enterprises (SMEs) and research centres can increase the level of innovativeness in an economy. The role of intermediaries is recognised as the best way to connect SMEs and research centres. Most practical experiences demonstrate this assumption and there are several scientific articles illustrating organisational and social aspects of intermediaries, as well as activities developed in the technological transfer processes.

In this perspective, brokering is a process aimed at improving the exchange of knowledge between two or more communities and it facilitates the exchange of information about innovation among companies and research centres. Brokerage processes can be viewed from different perspectives: as a contributor to innovation by facilitating knowledge integration (*Innovator role*, Cohen and Levinthal, 1990; Hargadon and Sutton, 1997; Cillo, 2005); as a facilitator in the diffusion within a social system of new ideas coming from outside the system (*Facilitator role*, Aldrich

and von Glinow, 1992); as a developer of new applications for new technologies in new ways (*Seeking role*, Hargadon, 1998); or as a gaps filler in information and knowledge in industrial networks (*Bridge role*, Provan and Human, 1999). From an organisational point of view, brokerage activities can be structured as an agency, as a governmental institution or in an actor's perspective. Our assumption will start from an actor's perspective. Being a broker will not appeal to everyone. Whether or not people emerge as brokers seems to depend on the characteristics of people and the context in which they work (Kyrkels and Duyster, 2010). Indeed, the broker's role and characteristics depend on several factors: environmental and production context, kind of network the broker is involved in, width of key activities performed by the broker, broker's affiliation, role of the partners.

Literature is still lacking in field analysis about competences and skills that a technological broker should possess. The broker's skills and competences are contextualised based on specific attributes of the environment that the broker is involved in, and also on how the network of firms, institutions and research centres is structured.

The aim of this paper is to analyse the broker's skills and competences as a critical issue in successful brokerage processes. In particular, the following research questions will be dealt with in the paper:

- Which is the role of the broker from an actor's perspective?
- Which competences does he/she need to have?
- How can brokerage processes develop, based on their regional context?
- How can training programmes be planned, leading to a widespread broker professional profile?

To answer these questions, a methodological proposal will be made, following a competence-based theoretical approach to map the competence profile of a technological broker. The methodology is based on the attempt to test knowledge of a set of competences which brokers should own to improve the level of innovativeness in a specific regional context. The mapping of competences is performed through a set of exploratory case studies. Interviews with successful brokers will exploit competences and skills that a broker should own in order to foster cooperation between firms and research centres.

The paper is structured into four main sections. Firstly, a literature review will be conducted on the broker's role and activities. Then, the research approach will be proposed, and results from six case studies will be presented. Finally, discussion and conclusions will be drawn.

3.2 The broker as an intermediary between SMEs and the world of research

In the context of SMEs, the importance of third parties in building interfaces and developing knowledge is acknowledged in innovation and SME literature (Kaufmann and Tödting, 2002; Sapsed et al., 2007). The need for cooperation in an environment characterised by uncertainty, complexity and rapid technological progress (Acs et al.,

1996) urges SMEs to establish relationships with other actors and, above all, with the world of research. The process of transferring research knowledge into action is recognised as messy and complex (Graham et al., 2006), as entrepreneurs and researchers inhabit different worlds (Caplan, 1979). Research is characterised by the study of theory and concept which take a lot of time, by a peculiar, highly technical language, while enterprises are looking for research activities which are relevant for their business and easy to understand and apply (Mitton, Adair et al., 2007, Choi, Pang et al., 2005). Moreover, SMEs feel the urge to cooperate with others in order to acquire knowledge and other competences, but they often face difficulties in finding partners and they often lack the knowledge basis to be able to absorb the required knowledge (Kirkels and Duysters, 2010). In this perspective, intermediaries have a key role in the technology transfer process, and generally speaking in the innovation process. Indeed, a broad literature has pointed out that innovation processes are carried out through intensive cooperation among different actors, where some of them act as bridging agents (Howells, 2006). In the innovation process, bridging actors are true innovators, since they identify process and use ideas developed in different industries or fields to the advantage of their organisation (Cohen and Levinthal, 1990; Hargadon and Sutton, 1997; Cillo, 2005). Their role goes beyond intermediation, since it contributes to innovation by facilitating the integration of knowledge (Hargadon, 2003; Howells, 2006). The term “broker” is used in literature to identify agents “facilitating the diffusion in a social system of new ideas from outside the system” (Aldrich and von Glinow, 1992), “seeking to develop new applications for new technologies in new ways” (Hargadon, 1998), “filling gaps in information and knowledge in industrial networks” (Provan and Human, 1999).

Briefly, a Knowledge Broker (KB) provides a link between research producers and end users by developing a mutual understanding of goals and cultures, collaborates with end users to identify issues and problems for which solutions are required, and facilitates the identification, access, assessment, interpretation, and translation of research evidence into local policy and practice. Knowledge brokering can be carried out by individuals, groups and/or organisations, as well as entire countries. In each case, the KB is linked to a group of end users and focuses on promoting integration of the best available evidence into policy and practice-related decisions. For Nooteboom et al. (2007), the integration of knowledge by the broker is even more important when the relevant knowledge is acquired from domains that have different languages and concepts, such as researchers and SMEs.

Table 3.1 Definition of the Broker's role: a literature review

<i>Broker's role</i>	<i>Definition of the broker's role</i>	<i>Reference</i>
Innovator role	The broker identifies, processes and uses ideas developed in different industries or fields to the advantage of their organisation or in general. Innovator role, since the broker contributes to innovation by facilitating the integration of knowledge	Cohen and Levinthal, 1990; Hargadon and Sutton, 1997; Cillo, 2005
Facilitator role	The broker facilitates the diffusion in a social system of new ideas from outside the system	Aldrich and von Glinow, 1992
Seeker role	The broker develops new applications for new technologies in new ways	Hargadon, 1998
Bridging role	The broker fills gaps in information and knowledge across industrial networks	Provan and Human, 1999
Process Role	The broker is a process which improves the exchange of knowledge between the two communities and facilitates the exchange of information about innovation amongst companies	CHSRF, 2003; Spencer, 2003; Pawlowski and Robey, 2004; Wolpert, 2002

3.3 The broker's activities and competences

According to Fernandez and Gould's brokering structures (1989), the broker can belong to one of the two organisations to connect, or it can be external to both organisations. Kirkels and Duysters (2010) adapted Fernandez and Gould's brokering structure to the innovation process and identified five types of brokers (Figure 3.1).

The brokering structure affects the activities carried out by the broker to manage the innovation process; therefore it is complicated to infer a complete list of broker's activities. As for the broker's functions, on the basis of a literature review Klerkx and Leeuwis (2009) identified the following functions:

- demand articulation: articulating innovation needs and corresponding demands in terms of technology, knowledge, funding, and policy;
- network formation: facilitation of linkages between relevant actors (scanning, scoping, filtering, and matchmaking of possible cooperation partners);
- innovation process management: enhancing alignment and learning of the multi-actor network, which involves facilitating learning and cooperation in the innovation process.

In a literature review, Howells (2006) emphasizes similar functions: foresight and diagnostics; scanning and information processing; knowledge processing and combination/recombination; gatekeeping and brokering; testing and validation;

accreditation; validation and regulation; protecting the results; commercialization; evaluation of outcomes.

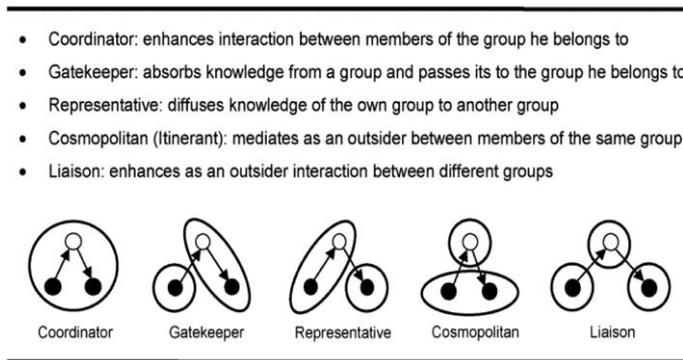


Figure 3.1 Broker types in innovation processes (Kirkels and Duysters, 2010, adapted from Gould and Fernandez, 1989)

Considering the broad literature on the broker’s activities, several contributions may overlap. A synthesis of the available literature is suggested in Table 3.2.

Table 3.2 Types of activities in the technology transfer process

<i>Types of Key Activities</i>	<i>Description</i>
<i>Firm’s innovation needs identification</i>	<i>Implementation of a systematic and regular audit of the enterprise’s technological needs, so as to identify initial and on-going needs; to analyse emerging trends Implementation of an organisational audit</i>
<i>Innovation goals identification and selection</i>	<i>Assessment of new technologies and innovation priority setting</i>
<i>Acquisition and planning</i>	<i>Planning and acquisition of investments for a research and development project</i>
<i>Exploitation and protection</i>	<i>Innovation exploitation and patent protection</i>
<i>Networking</i>	<i>Building, maintaining and expanding networks among R&D providers and users</i>

As far as brokers’ competences are concerned, we focused on the role they played in helping SMEs find competent partners providing them with complementary assets and resources for sustaining innovation processes. In fact, the limited resources and time to spend on learning to acquire knowledge (Lavie and Rosenkopf, 2006;

MacGregor, 2004; Narula, 2004; Powell et al., 1996) and limited scanning ability prevent SMEs from finding competent partners. In this perspective, Kolodny et al. (2001) identified the following requirements as essential for the proper functioning of innovation brokers: visibility and accessibility to SMEs, trustworthiness to SMEs, access to appropriate sources of knowledge and information relevant to the innovation process, credibility of the intermediary organisation with these sources, quick response to the requests of SMEs, and complementarity to the weaknesses of the SMEs it serves. Bessant and Rush (2005) emphasize how managerial capabilities are also needed to transfer knowledge. Other main skills for the broker, related to the success of this activity, are: expertise from both end users' and researchers' domains (Pyper, 2002; Jackson-Bowers et al., 2006); ability to tailor the key messages from research evidence to the local/regional perspective, ensuring that the "language" used is meaningful for different end users (Hargadon, 2002; Lavis et al., 2003; Wolpert, 2002); capability to develop a trusting and positive relationship with end users and to assist them to incorporate research evidence into their policy and practice decisions (Lavis et al., 2003; Roy et al., 2003); capability of creating networks of people sharing common interests (Loew et al., 2004; Zook, 2004). As highlighted above, the KB role is not unique but a challenging one, since brokering activities can take on different characteristics based on the following aspects:

- environmental and productive context;
- kind of network the broker is involved in;
- width of key activities performed by the broker;
- broker's affiliation; role of the partners.

Thus, a broker's skills and knowledge vary on the basis of specific situations the broker is involved in. This accounts for the unusualness of developing a general and generalizable competence profile for the broker. Instead, different broker activities should be mapped and only at the end of this analysis, a profile of the broker's competences should be developed. Focusing on SMEs, the paper deals with this issue and tries to draw up a broker's profile in terms of competences and skills through a case study analysis' approach. Thus, two case studies of different brokers acting in different contexts will be presented, in order to collect information about brokers' competences.

3.4 Theoretical background of skills and competence representation

The predominant view in managerial practice assumes that competences are "universal" constructs whose meaning is independent from the specific organisational context in which they are activated and developed (Sandberg, 2000). This universalist approach can be traced back to the well-known McClelland studies (1978), an approach in which competences are mapped by using statistics to identify those behaviours distinguishing average from best performers, and to Spencer and Spencer's (1993) surveys aimed at identifying general competence profiles for standard professional figures.

The widespread adoption of the universalist approach is mainly due to the fact that it is usually quite easy to adapt pre-existing competence codebooks and standard profiles instead of performing time-consuming and expensive field analyses.

In managerial practice, due to the high costs of extensive field analysis, the universalist approach is applied in a *deductive* sense: competence profiles are usually defined as top-down through the use of standard codebooks, in which the description of each competence (i.e., its meaning) is usually general enough to fit into many different contexts and work situations. Furthermore, the “universalist” approach ensures a high degree of efficiency through standardisation of competence codebooks.

However, the effectiveness of this approach has often been questioned, since it suffers from several conceptual and practical limitations (Zingheim, Ledford and Schuster, 1996).

On the conceptual side, increasing standardisation through a top-down definition produces a paradox: whereas in the competence-based theory of the firm (Pralhad and Hamel, 1990) competences are distinctive, value-creating, and inimitable assets, in everyday practice most organisations end up with similar competences. For these reasons, the use of generalised competence models has been criticised by Boyatzis (1998), who suggests limiting the use of standard codebooks and developing an in-depth qualitative analysis for eliciting competences.

As an alternative to the universalist perspective, competences are deeply influenced by organisational culture, social interaction, and the unique way people make sense of their jobs within organisations (Le Boterf, 2000; Levy-Leboyer, 1996; Sandberg, 2000). These approaches are called *situationalist*, since they share the perspective that competences are idiosyncratic, situated constructs. In the situationalist perspective, individuals can be considered as competent *within a tradition* (Polanyi, 1967).

In other words, individual competences are strictly related to the social context in which they are activated and developed through time.

The specific characteristics of the broker’s role and of the context in which he/she operates, as highlighted in Paragraph 2, show that it is not possible to standardise brokers’ activities and competences, since they are strictly linked to brokerage types, broker’s affiliation and object. For these reasons the situationalist approach is more suitable to map brokers’ competences. This is also due to the fact that the situationalist approach is more concerned about contingent factors characterising the socially constructed nature of competence (Berger and Luckmann, 1966; Giddens, 1979) and the network of social and technical ties (Akrich and Latour, 1992; Latour, 1992) in which the broker is involved.

Following the situationalist perspective, in this article we suggest the following definition of competence: *an individual ability or characteristic that is activated by an individual together with personal, organisational or environmental resources to cope successfully with specific work situations or specific projects.*

Individual abilities and characteristics are personal attributes such as skills, know-how, and traits.

Resources are means for action such as tools, facilities, relationships with other people, archives, and knowledge repositories that are made available by the individual, the organisation, or the external environment as a whole.

According to the situationalist approach, individual competences can be mapped starting from the analysis of the explanations through which the members of an organisation make sense of their actions (Schank, 1986; Weick, 1979). Consequently, to elicit competences, one needs to have suitable techniques for analysing examples of explanatory discourse. In our research, we adopted this technique through semi-structured interviews to 6 successful brokers. Each interview was analysed through the argument-analysis technique proposed by Fletcher and Huff (1990), in order to identify arguments and reasons that the interviewees provided to explain their excellent performance. The argument analysis maps the argument structure in order to identify key claims, facts provided as evidence for claims (grounds), inference rules used by the speaker (warrants) and linguistic expressions limiting the validity of a claim or a rule.

Data acquired from the interviews were coded through description of the recurrent definition of specific competences, according to the broker's key activities identified and the competence elements taken into consideration (see paragraph 5.3). The coding forms were discussed with the brokers in order to obtain shared definitions of competences.

3.5 The research

Explorative research is aimed at exploiting the competences of different types of brokers operating in different situations. The mapping of competences was performed through a set of explorative case studies. Actually, six case studies were completed. In the table below, the main characteristics of the case studies are reported.

The selection of the case studies presented in Table 3.3 is the result of a wide array of institutions and professional figures working in the Campania region, acting as technology brokers. After a first round of calls and requests for interviews, only four out of more than 15 broker candidates accepted to participate in the interview. Unfortunately, it must be highlighted that a large part of the regional institutions whose mission is technology transfer did not respond to our invitation to be interviewed. Thus, further case studies were selected in other regions close to the Campania region. Indeed, Calabria and Apulia regions were selected due to their similarity to the Campania region in terms of Gross Domestic Product (GDP).

All interviewed brokers reported on innovation projects that can be considered successful, thus the results are reliable and usable for further analysis. The success stories are rated based on the fact that, as will be later shown, all the brokers activated a set of competences, and the result of such activation was the creation of a new product/process, a spin-off or a patent.

Table 3.3 Summary of case studies

Case study	Broker	Type (based on Kirkels and Duysters, 2010)	Innovation project	Region
1	Entrepreneur	Gatekeeper	Product innovation	Campania Region
2	Entrepreneur	Gatekeeper	Product innovation	Campania Region
3	Consultant	Gatekeeper	Process innovation	Campania Region
4	Manager	Gatekeeper	Process innovation	Campania Region
5	Employees in a Liaison Office	Liaison	Spin-off	Calabria Region
6	Employees in a Liaison Office	Liaison	Patent development	Calabria Region

3.5.1 Definition of competences

As far as the definition of competences is concerned, we refer to the European Credit System for Vocational Educational and Training (ECVET) of the European Commission for Education and Culture.

According to ECVET, competence is “the proven ability to use knowledge, skills and personal, social and/or methodological abilities in work or study situations and in professional and personal development”. Skills are “abilities to apply knowledge and use know-how to complete tasks and solve problems”. Knowledge is “the outcome of the assimilation of information through learning. It is the body of facts, principles, theories and practices that is related to a field of work or study”. According to these definitions, each competence can be considered as a whole range of specific skills, each of them being supported by a relevant subset of skills.

3.5.2 Methodological approach

The exploratory nature of this study suggests the use of a qualitative methodological approach. Thus, case studies are a useful tool to understand the complex nature of entrepreneurship, as recommended by Gartner and Birley (2002). The aim of each case study was to understand, for each interviewed broker, the key competences they activated. Cases are based on semi-structured interviews with brokers. Starting from their personal story and career, the interview covered the following topics: a specific and relevant project where his/her abilities as broker played a critical role, the main key activities of the project, the key competences activated.

3.5.3 Interview procedure

For each case study, we conducted an in-depth interview with the brokers. The interview was aimed at revealing the key competences to perform a successful technology transfer project and it was mostly focused on the following points:

- professional experience and curriculum of the broker (how he/she developed his/her early competences);
- the project “under consideration”: aim, history, main phases, critical events, others;
- performance of the project: Which kind of performance? How can it be measured?;
- factors affecting the success of the project, above all concerning the territorial context and the actors contributing to sustaining SMEs’ innovation;
- knowledge and skills that the broker was able to implement for a successful project;
- knowledge and skills that the broker felt were lacking for a successful project.

The analysis and codification of interviews will allow to collect brokers’ competences through an inductive analysis with a bottom-up approach, according to ECVET standards, and to analyse the role of the territorial context in sustaining the brokering process or not, activating specific resources and complementary competences with respect to those owned by the broker.

3.6 Case study results

In this section, a brief description of Campania’s specific context will be given, and results from case studies conducted in this region will be presented through the following structure:

- case study overview;
- broker’s experiences and broker types based on Figure 3.1;
- innovation project analysed;
- competence profile based on the key activities reported in Appendix B.

A total of six case studies will be presented, in which face-to-face interviews were conducted with brokers involved in implementing innovation projects. The final result, i.e. the broker’s competence profile for each case, is reported in Appendix B.

3.6.1 Geographical and economic context

Campania is a region in Southern Italy (Figure 3.2). It has a population of around 5,8 million people, making it the second most populous region of Italy; its total area of 13,595 km² makes it the most densely populated region in the country. Located on the Italian Peninsula, with the Tyrrhenian Sea to the west, the small Flegrean Islands and Capri are also administratively part of the region.

Unlike Central and Northern Italy, in the last decade the region of Campania has not attracted large numbers of immigrants. In January 2007, the Italian National Institute of Statistics (ISTAT) estimated that 98,052 foreign-born immigrants live in Campania, equalling only 1.7% of the region's total population. Part of the reason for this is that in recent times, there have been more employment opportunities in the Northern regions than in the Southern Italian regions.



Figure 3.2 Campania region

Brief historical profile: Throughout much of its history, Campania has been at the centre of the Western Civilisation's most significant entities. The area was colonised by Ancient Greeks and was within Magna Græcia, until the Roman Republic began to dominate. During the Roman era the area was highly respected as a place of culture by the emperors, where it balanced Greco-Roman culture. The area had many duchies and principalities during the Middle Ages, in the hands of the Byzantine Empire and some Lombards.

It was under the Normans that the smaller independent states were brought together as part of a sizable European kingdom, known as the Kingdom of Sicily, before the mainland broke away to form the Kingdom of Naples. It was during this period that especially elements of Spanish, French and Aragonese culture touched Campania. Later the area became the central part of the Kingdom of the Two Sicilies under the Bourbons, until the Italian unification of 1860 when it became part of the new State of Italy.

The capital city of Campania is Naples. Campania is rich in culture, especially with respect to gastronomy, music, architecture, archaeological and ancient sites such as Pompeii, Herculaneum and Paestum. The name of Campania itself is derived from Latin, as the Romans knew the region as *Campania felix*, which translates into English as "fertile countryside". The rich natural sights of Campania make it highly

important in the tourism industry, especially along the Amalfi Coast, Mount Vesuvius and the island of Capri.

Economy: at national level, the Campania region ranks 7th in terms of GDP. According to Eurostat, the European Union's Statistical Institute, Campania is one of the regions with the lowest GDP per person in Western Europe.

Traditionally, Campania is the most industrialised region of Southern Italy; in particular, at the beginning of the 20th century the territory of Naples was one of the most industrialised areas of Italy, preceded only by the provinces of the "industrial triangle" (Milan, Turin, Genoa).

In recent decades the gap with other regions grew, as southern regions like Apulia and Abruzzi experienced significant economic growth, while, paradoxically, Campania went through a steady process of de-industrialization.

The agro-food industry is one of the main pillars of Campania's industry. The organisation of this sector is improving and leading to higher levels in terms of quality and salaries. Campania mainly produces fruit and vegetables, but has also expanded its production of greenhouse-grown flowers, becoming one of the leading regions of the floricultural sector in Italy. The added value of this sector represents around 6.5% of the region's total added value, equalling 213.7 million EUR. Furthermore, Campania produces over 50% of Italy's nuts and is also the leader in the production of tomatoes, which reaches 1.5 million tonnes a year. However, a weak point for the region's agriculture is the very small size of farms, equalling 3.53 hectares on average. Farm animal breeding is widespread (there were 70,278 breeding farms in 2000) and the milk produced is used to process typical products such as mozzarella. Olive trees cover over 74,604 hectares of the agricultural land and contribute with 620.6 million EUR to the added value of agriculture, together with the production of fruit. Wine production has increased, together with the quality of the wine.

The mechanical sector is also important, characterised by the Alfa Romeo plant in Pomigliano d'Arco, Firema in Caserta, Avellino and the FMA yards of Castellammare di Stabia and Naples. The aerospace industry has one of its most important poles in Campania with Alenia Aeronautica. Solofra, a municipality in the province of Avellino, not far from Salerno, is one of the leading European production districts for the leather and leather tanning industries, and there are also many chemical plants in the area such as BASF.

The port of Naples and the port of Salerno are among the most active in Italy for moving goods and passengers (the latter particularly in Naples), a project for building a rail link between the Port of Naples and the Freight Village of Nola is also under way.

The handicraft sector includes the production of shoestrings and cords, working with clay and ceramics (including the famous Capodimonte china and Vietri sul Mare pottery), fine silk in San Leucio (Caserta) and the cribs of Via San Gregorio Armeno (a street of Naples). Marcianise, near Caserta, is one of the most important goldsmith industrial districts in Italy.

Tourism is supported by the abundance of artistic and natural beauties, attracting millions of people every year, and tourism activities are especially thriving in the peninsula of Sorrento, the Amalfi coast and Cilento.

Overall, Campania is a region with an enormous economic potential, as well as other regions of Southern Italy, unfortunately hampered by the mismanagement of the territory's potential and by the presence of organised crime in some areas.

Overview of technological transfer activities in the Campania region: based on a wide availability of intermediaries in the Campania region, and applying the triple helix model, we identified about 10 intermediary organisations. This easily reveals the high level of overall resources, skills and competences in the Campania region. Such resources can be found both in the Research Institutes and in the Local Institutional Organisations.

However, several critical aspects must be highlighted. Indeed, such criticalities can be actually considered as barriers to the effectiveness and sustainability of the feasible cooperation that could be implemented between the field of research and the world of enterprises.

In the following table, the main critical factors are highlighted based on our field experience.

Table 3.4 Organisational structure of intermediaries in Campania

Type of intermediary	Organisational and human resources	Actual perception of benefits in cooperating with firms
Universities and Research Centres	<ul style="list-style-type: none"> • Limited networks among research departments • Absence of an effective management transfer unit • Absence of monitoring systems on the results achieved through cooperation with firms • Low experience and capability to address research projects to solve a firm's problems related to the life cycle phases of specific new products: early stage, planning stage, prototyping stage, experimental stage, industrialisation stage • Only recently, universities are trying to map in-depth technological competences and services that could be offered to firms. The problem is that, usually, the language and terms are only partially clear and shared, and, thus, useful for entrepreneurs 	<ul style="list-style-type: none"> • High expectations about academic career and publications • Low interest and perception of benefits in cooperating with firms

	<ul style="list-style-type: none"> • Absence of a rate table for the technical and technological advisory services, and high bureaucracy for the agreement between firms and departments 	
Firms	<ul style="list-style-type: none"> • Absence of a research team and of an R&D department of technological experts within the firm that can interact with the research team • Low propensity to finance research projects • Limited experiences of cooperation with universities/research centres 	<ul style="list-style-type: none"> • Perception of excessive theoretical approach in universities and research centres • Scarce knowledge about technological competences in the world of research and opportunities to exploit it for solving firms' problems • Perception of universities and research centres as organisations being too far from the real world of firms • Perception of researchers as only partially able to address their research activities towards specific problems faced by firms • Perception of limited alignment between the results of research and the real technical needs of firms • Limited perception of possible benefits derived from cooperation with universities and research centres

3.6.2 Case Studies

Overview of the Case Study 1: the first case dates back to the late 1970s, a period in which Olivetti's OMO (*Officina Macchine Operatrici*), in cooperation with the Polytechnic of Milan, had developed the first industrial robot equipped with features enabling it to assemble mechanical parts and electronic components of very different size, in addition to drilling, milling and threading steel and light alloy with appropriate tools. The robot was called SIGMA – an Integrated General-Purpose System for Automatic Manipulation - and it was digitally programmed and controlled by a computer, "PDP 11/40", with programming data being entered into the system through a teletype machine by Olivetti, compiled and edited using a language called CODE. At the beginning this robot became very popular, but this popularity decreased over time, owing to a few critical limits in terms of instability and slowness. The broker interviewed (an engineer) was hired in 1978 because of his specific technical background. It was crucial to transform the robot prototype into an

industrial application, through an innovation project to be carried out quickly, so that the company would not lose its competitive edge against competitors. The business skills were not sufficient, however, for early completion of the project. The knowledge areas critical to the success of the project were identified as those of applied mechanics, hardware and software. It was therefore necessary to select appropriate technology partners from the world of research, with whom to establish a successful professional relationship.

The broker's experience at the time of the innovation project

At that time the broker, an engineer, was 50 years old. At the age of 25 he had received his master degree in Electronic Engineering at the University of Naples Federico II. After a short period of cooperation with the university, he was employed at Texas Instruments in the R&D area, in the company's premises near Naples. Later, he became R&D Executive Manager in the Machine Control Department. During that period, he filed several patents. Afterwards, he was chief of the Quality Assurance Area and Head of the Manufacturing Area. He was Project Manager, too, in the development of a new line of products for Texas Instruments America in Attleboro, MA, US, and he worked in close cooperation with the Massachusetts Institute of Technology (MIT). In 1979 he was employed by Olivetti Sistemi per l'Automazione Industriale SpA in Marcianise, Italy, and in 1981 he worked for Olivetti's Numerical Control Division.

It can be stated that this broker acted as a gatekeeper, based on the definition reported in Kirkels and Duyster (2010).

The innovation project

The project for transforming the robot prototype into an industrialisable one was developed through the following phases:

1. design of new characteristics: hardware, software and mechanical ones ("Innovation needs identification" and "Innovation goal identification");
2. identification and selection of the partners for the technology transfer ("Acquisition and planning");
3. partnership codification ("Networking");
4. marketing of the robot ("Exploitation").

Two main technological partners were involved in the project:

- Department of Production and New Materials Engineering, University of Naples "Federico II", selected because of the mechanical knowledge and competences;
- Department of Information and Systems of the University of Naples "Federico II", because of the hardware and software knowledge and skills.

During the fourth phase, close collaboration was developed between the two departments and the company. Through the role of coordinator played by the broker, who took on the project management of this cooperation, several degree dissertations were developed. During the development of the work, master degree students and their tutors spent some time in the company and cooperated with the broker to define technical specifications, starting from functional specifications of the product to be developed, and subsequently leading to the development of the executive projects related to mechanics and electronics (hardware and software). The results of these

activities were achieved in just one year. In the following period, the product was successfully marketed, thanks to its innovative content and its great versatility. It was then sold to the American market (Westinghouse).

Overview of the Case Study 2: the innovation project concerns the design and implementation of a new plant to innovate the production process. For medium-sized businesses, the availability of individual furnaces respectively operating for the sintering of stainless steel or processing of sinter-hardened materials involves plant costs and levels of use that are not competitive. For this reason, the project includes the building of a new multi-purpose plant for both above-mentioned functions, as well as for reaching high temperatures for the sintering of iron-based materials.

Despite difficulties encountered in the starting phase, the new multi-purpose furnace for high-temperature sintering has shown the full validity of the idea lying at the basis of the project.

The broker's experience at the time of the innovation project

The broker, who had graduated in 1963 in Chemical Engineering, was employed at Merisinter (production of mechanical components) from 1963 until 1985, during which time he conducted research in cooperation with the Faculty of Engineering, and produced several publications. He also worked as master degree tutor, dealing with several problems related to mechanical engineering. These experiences proved very useful for his future career prospects, because they allowed him to “tune into the wavelength” of researchers when it came to managing technology transfer projects.

An outstanding experience of cooperating with the university came from the resolution of a specific problem: failure of an elastic shock absorber for cars. Cooperation with a professor of mechanical engineering proved to be very useful for detecting and solving problems. Subsequently, the broker worked at Höganäs Italia (powder manufacturing by sintering) from 1985 to 1997, and since 1997 he has been a consultant in the field of powder metallurgy. Finally, from 1995 to 2005 he was Professor of powder metallurgy at the Milan Polytechnic.

In the previously described project development experience, the broker acted as a gatekeeper following the definition reported in Kirkels and Duyster (2010).

The innovation project

Given the novelty of the plant development, the decision was made to integrate it with:

- a first section of rapid cooling;
- a chamber of carbon enrichment or “normalization”;
- a second section of rapid cooling.

Based on this information, the innovation process can be described through the following key activities:

- innovation goals identification;
- acquisition and planning;
- developing cooperation with partners (“Networking”);
- production environment and testing (“Exploitation”).

The technology partners involved in the design stage were the Milan Polytechnic and the Department of Metallurgy, Faculty of Chemistry, University of Genoa, during

the system development stage (before that, they worked at solving some problems of malfunctioning).

In the furnace development phase, a German supplier was contacted for the optimal positioning of the heating elements in the furnace and, more generally, to ensure optimal functioning parameters for the furnace compared to the requirements concerning the tempering process. The final design stage fully complied with the metallurgical requirements, but the implemented strategy to ensure compliance with these requirements was the responsibility of the furnace manufacturing company.

Overview of the Case Study 3: the innovation project concerns the production line of pasta made from raw materials of certified origin (2001). This innovation was the result of a research and development process which, in just a few years, led to the launch of a new product. As well as the will and the innovative spirit of the entrepreneurial group, the relationship set up between the enterprise and public research bodies, in particular with universities, proved to be of crucial importance. Planning by the organisation to accomplish such a complex innovation was particularly significant.

The broker's experience at the time of the innovation project

At the time of the innovation project, the entrepreneur had already graduated and he was the second generation in the firm's management control.

He acted as a central pivot in the building of a cooperation network between the firm and research centres. This ability can be considered as one of the most important competences achieved by the entrepreneur.

This ability was due to his willingness to participate in national and international meetings where academics used to suggest and illustrate their innovative ideas, in search for a technological partner to market them.

It can be stated that the entrepreneur acted as a gatekeeper, following the definition reported in Kirkels and Duyster (2010).

The innovation project

In this particular innovation project, the high level of cooperation with research centres was motivated by the low level of the firm's internal research and development capabilities. The project was developed through the following phases:

- development of a new product ("Innovation needs identification");
- define the characteristics of the new product; supply chain integration ("Innovation goals identification");
- identification and selection of partners for technology transfer activities ("Acquisition and planning");
- partner cooperation development ("Networking");
- supply chain integration ("Exploitation").

Overview of the Case Study 4: in 2003, the Entrepreneur, fortified by years of experience in the sector and confident about the need to suggest a differentiation strategy to the end-user, understood the importance of offering a product whose characteristics could be objectively identified by means of scientific analysis. He managed to identify research centres having the right competences for undertaking

the project, in that a substantial scientific research phase was required to identify the organoleptic features of the product. The ability to produce an olfactometer within a shorter time span and at lower costs vis-à-vis the initial plans was due to the high project management skills. The suggestions provided by the sales personnel and by the company's R&D department personnel to the entrepreneur were critical in the project phase of system experimentation. In this phase, cooperation with universities and research centres proved to be effective.

The broker's experience at the time of the innovation project

The entrepreneur's cultural and educational background at the time of the innovation project was extremely diverse. Such diversity was one of the main reasons for the success of the project.

In general, as a broker the entrepreneur played a gatekeeper role, following the definition reported in Kirkels and Duyster (2010). Indeed, he developed high cooperation skills and he had a wide knowledge of research centres and universities in Southern Italy that he could collaborate with.

The innovation project

The project was developed through the following phases:

- development of a new production process ("Innovation needs identification");
- define the characteristics of the new process; supply chain integration ("Innovation goals identification");
- identification and selection of partners for technology transfer activities ("Acquisition and planning");
- partner cooperation development ("Networking").

Overview of the Case Study 5: the Liaison Office - LiO - of Calabria University, being the object of case studies 5 and 6, has been active since 2003 through well-structured technology transfer activities, with a complete chain structure ranging from the support of applied research to business creation.

The strategy and the activities for innovation and technology transfer at the University of Calabria are based on two key elements:

- strengthening links with the business system, facilitating and actively seeking for opportunities to cooperate with companies from Calabria and supporting systematic and organised contacts with national and international firms;
- enhancing the results of research, by means of coordinated policies to promote patenting and business support spin-offs from research and the creation of innovative start-ups.

Within its organisation, LiO's main processes are:

- communication (newsletters, website, helpdesk);
- intellectual property services;
- specialised training;
- support firms' planning and design activities;
- relations with companies, institutions and other socio-economic premises;
- payment of royalties.

The most significant projects carried out in recent years have focused on the exploitation of the research results. Brokers are then engaged in activities mainly related to “innovation, patent protection and exploitation”.

As for possible roles within the classification by Kirkels and Duysters (2010), the one that comes closest to LiO’s broker is the gatekeeper, since it facilitates the transfer of researchers’ tacit knowledge from the University of Calabria and is codified into explicit knowledge through the achievement of the joint ownership of patents by the University.

Currently, the University of Calabria has a portfolio of 41 patents, with cases of successful licensing to companies (9 licenses granted) and 21 spin-off companies from research.

The exploitation of research results is therefore the main strategic objective and the prevailing trend of LiO’s activities.

Brokers are all internal to the LiO and they have a mainly technical background. Some of them have attended a Master in Technology Transfer and Innovation Brokering Science organised by the Scientific and Technological Park of Trieste, in collaboration with the Polytechnic of Milan. They report to the Liaison Office and are specialised in specific activities (communication opportunities, design support, intellectual property, creating spin-offs and start-ups), they are also coordinated by two "senior" brokers.

One of LiO’s future prospects is related to the creation of a project network for young brokers, through:

- the selection and recruitment of young graduate students in technical, scientific and economic disciplines;
- training in their use of research results and business creation;
- participation in internships and placements within a long-term business brokering perspective.

The broker’s experience at the time of the innovation project

Brokers are engaged in activities primarily related to the “exploitation of innovation and patent protection” and they mainly act as gatekeepers. This role is exploited in two different activities:

- stimulating the development of patents by the universities’ internal researchers, and assisting patent implementation, by facilitating the transfer of tacit knowledge owned by researchers at the University of Calabria and codified into explicit knowledge through the creation of patents owned by the University;
- the creation of spin-offs by young graduates of the University, through the exploitation of research results or the use of patent co-ownership of the University. As part of that business, graduates are assisted by brokers in the “reinterpretation” of scientific knowledge and collaborate with researchers to develop business ideas. In addition to the broker’s support, young graduates are entitled to seek advice from venture capital companies. LiO policies are aimed at helping graduates in the business plan development and in financially supporting their spin-off.

The innovation project in the Spin-Off activities

The following section will focus on the role of brokers in the development of patent activities. Interviews with the brokers showed that, within these activities, a key element is represented by their ability to persuade researchers about the opportunities – with reference to the development of their research and their financial viability - that may arise from the codification of their knowledge, through the creation of usable inventions to be marketed.

The framework of skills activated by brokers, as it emerged from the interviews, is shown in the Table 5b in Appendix B.

Overview of the Case Study 6: as regards the line of activity for supporting the creation of spin-offs by young university graduates, the interviews showed that the brokers' critical skills are primarily related to:

- the brokers' ability in the "reinterpretation" of scientific knowledge developed by the university researchers, in order to identify business ideas to be proposed to young graduates;
- the ability to provide young graduates with the tools and methods for the development of business plans within a short time;
- the ability to build supporting networks for groups of young graduates capable of providing both adequate funding and specialist advice.

The Table 6b in Appendix B shows a complete overview of the skills activated by brokers, in relation to the line of activity for supporting the creation of spin-offs by young university graduates as resulted from the interviews.

3.7 Discussion

As literature highlights, the identification of competences and skills is a very difficult task because of the specific characteristics of the geographical and economic context. But literature also stresses the broker's critical role in fostering SMEs' competitiveness. This bridging role needed among different actors of the innovation system has led governments to invest in bridging structures, such as liaison offices, technology transfer offices, competence centres whose aim is to promote networking among territorial actors and to support technology transfer. Nevertheless, the impact of this structure is very low. Therefore, in order to better understand how to promote innovation within SMEs, efforts have been made to deal with this issue starting from competences needed in SMEs. It was not the authors' intention to understand how a bridging structure acts but, based on the analysis of successful innovation projects, the attempt was made to understand how the proposed methodology can infer critical competences, skills and knowledge of the broker figure. For all the 6 case studies presented in this paper, at the time of the innovation project analysed in the case studies, all competence profiles built on the basis of the results of the interviews had been considered very reliable by the brokers, as a clear picture of their competences. The additions and small changes suggested by the interviewed brokers to our reported

interviews were very limited. For these reasons we can assume that the methodological approach is reliable and useful to analyse the broker's competences. The methodology also proved to be efficient in that the "time consumption" required for the whole development of a case study (from the acquisition of information on the real situations examined in the preliminary review of the broker's skills profile) was assumed to be three days for each case.

Although the purpose of the work was the testing of a methodology in order to map brokers' skills and not to classify such competences, the wealth of data collected in the case studies allows us to make some preliminary remarks on the types of skills that brokers activated more frequently and systematically during the innovation projects. Obviously, these considerations should be regarded as hypotheses to be confirmed during the next research step leading to a thorough survey.

The following Table describes the broker, his/her role, the type of innovation project and the region involved.

Table 3.5 The Broker in the Case Studies

Case Study	Broker	Type (based on Kirkels and Duysters, 2010)	Innovation project	Region
1	Entrepreneur	Gatekeeper	Product innovation	Campania region
2	Entrepreneur	Gatekeeper	Product innovation	Campania region
3	Consultant	Gatekeeper	Process innovation	Campania region
4	Manager	Gatekeeper	Process innovation	Campania region
5	Employees in a Liaison Office	Liaison	Spin-off	Calabria region
6	Employees in a Liaison Office	Liaison	Patent development	Calabria region

First of all, the analysis of the six cases leads to the following considerations:

- 1. The innovation project is activated by the broker;*
- 2. In some cases the broker is a gatekeeper and belongs to SMEs;*
- 3. In some cases the innovation project is related to the technological needs of SMEs.*

The broker starts the innovation project so that the bridging role is related not only to the ability of creating a network of actors, but above all to understanding which network has to be created based on the project goals. In four cases the broker is the entrepreneur, so the brokering process starts from SMEs themselves. In these cases, the entrepreneur's background makes him/her able to understand the issue, to create the network through a selection of partners and to manage it in order to reach the expected goals. In these cases, entrepreneurs act as a bridging structure, and the brokering process is activated on a given technical problem. The broker uses his/her

competences for understanding the problem and managing a network of actors belonging to different contexts, thus he/she is able to speak different languages. In two of the six cases, the brokering process is guided by the intent to exploit scientific research for industrial applications. In such cases, the brokering process starts from research discovery.

Based on these considerations and by analysing the type of key activities carried out in the innovation project, as can be noticed, two different sets in the main activity types have been implemented based on the type of innovation project, i.e. product innovation vs. spin-off/patent innovation.

As far as product innovation is concerned, the innovation project is related to technological needs and the main activities are shown in Table 3.2. The innovation project starts from the technological needs of an SME (firm's innovation needs identification). In this activity, the background of the entrepreneur/broker, his/her skills and knowledge of the technical aspects of product innovation make him/her able to identify the most appropriate type of research centre for the specific innovation project (innovation goals identification and selection). In the innovation goals identification and selection activity, the capability to link specific technological problems to a research centre and, consequently, knowledge about competences and activities owned by the research centre are critical. After this phase, the acquisition and planning activity leads the broker to select the partner thanks to the broker's competence in the identification of requirements to be developed through cooperation, and to the broker's competence in speaking and understanding a scientific language. In the final activity, i.e. exploitation, the broker must use his/her competence in managing a project and understanding the role of each partner in the network. Of course, some competences, skills and knowledge can change while switching from one case to another, but it can be stated that the main competences activated are related to the following capabilities:

- technical problem identification;
- linking technical problems to research;
- partner selection based on the technical problems to solve;
- managing the network for the exploitation of research in product innovation.

The broker profile merges technical knowledge with scientific knowledge and managerial knowledge. Technical knowledge is used to identify the problem and the goals. Scientific knowledge is used to translate the technical goals into scientific language and to select the scientific partners. Managerial knowledge is necessary to manage the implementation of the innovation project in the production process.

For spin-off and patent innovation, it has been necessary to identify the specific key activities for the four types identified in Table 3.2. For this reason, it has been identified the technology scouting activity and the knowledge exploitation and codification activity. The broker's competences are joined together in order to acknowledge and collect technological knowledge developed by research groups, and to understand which technological knowledge can be useful for each industrial sector. For these activities, knowledge of the research activity process, of technology assessment methods and of industrial needs is very critical. Then, three other activities were identified: patent development assistance (for patent development

innovation projects), project planning, control and networking (for spin-off innovation projects). Competences concern the ability to support researchers in the patent process, and the ability to manage the patent filing process, thanks to knowledge of the type of research and patent process. For project planning, control and networking activities, competences concern the capability of development, coordination and selection of partners involved in spin-off creation. The knowledge basis for activating these competences is the knowledge of project management techniques, of consulting industry and venture capital activities. In these two case studies, the main competences activated concern the following capabilities:

- monitor and select technology trajectories to match industrial needs with research discovery;
- guide the researcher throughout the patenting process;
- create a network for spin-off creation.

Also in these cases, the background is a peculiar characteristic of the broker. Against this background, the broker can speak two languages: the scientific language and the industrial one. While technical competences are owned by researchers, a general scientific and industrial background leads the broker to act as a translator. Managerial competences are relevant, too, to lead the exploitation process through patenting or spin-off creation. However, it seems that a critical competence is the ability to select the best process for the exploitation of research. This implies that the broker must own appropriate knowledge of all possible tools to exploit the research results. In these two cases, as can be noticed, the broker activates different processes for the exploitation of the research results: patenting and spin-off.

By comparing the results of the six cases, the conclusion is that a broker's profile shall be characterised by:

- a general scientific and industrial background to speak the two different languages and to understand the technological trajectories;
- a technical background to translate research discovery into production process needs, or production process needs into a research problem;
- innovation project management skills, which involve a network of actors;
- decision-making competences for the selection of the most appropriate exploitation paths to launch the marketing of research discovery.

The six case studies show that the broker activates only a set of competences based on the innovation project, and they highlight the fact that the broker, as an individual, does not own all competences but is capable of creating a network to obtain the competences needed to successfully manage the innovation project. By reading these results from an educational perspective, two competence groups emerge: specific technical competences and technical-managerial competences. Specific technical competences depend on a specific innovation project, therefore they can be owned only by individuals with a specific academic degree and expertise as shown in case studies related to entrepreneurs. Instead, technical-managerial competences require a knowledge basis related to patent development, project management techniques, technological assessment tools and research processes. This store of knowledge is independent from the context and could be stressed in educational activities.

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From Industry-University Cooperation to Research Brokering in Estonia

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Although a small country, Estonia has made a choice: to be a centre of innovation. The Tallinn University of Technology - TUT - launched MEKTORY, an interdisciplinary innovation platform focused on practical science projects and based on cooperation between Universities and Enterprises. As a national institution, Enterprise Estonia - EAS - promotes business and regional development by supporting entrepreneurship, providing financial assistance, cooperation opportunities and training. Over the last 10 years, public and private efforts have made development possible that in 2011 allowed Estonia to reach the position of “innovation follower”. The role of the Innovation Broker is very important to connect the different components of the innovation system.

4.1 Estonia and its industry: current situation and training actions

The Republic of Estonia covers an area of 45,227 km², with a population of 1,340,000 inhabitants. Its industrial structure includes more than 460 machine-, metal- and apparatus building enterprises; more than a hundred of them are small with a number of employers from 1 to 5 and a turnover of less than € 100.000. Due to the existing well-developed network of roads, railways and ports, most of these enterprises are situated in Tallinn and its nearby region. The importance of machine building, metalworking and electronics (engineering industry) has increased remarkably during recent years in terms of exports as well as imports. Today this branch of industry is a leader in the Estonian economy.

The need for academic institution and enterprise co-operation has increased recently due to the restructuring of Estonian industry during the 2008-2010 economic crisis. Three fundamental phases of co-operation could be distinguished: educational

curriculum/training course development; interdisciplinary knowledge transfer platform development; as well as production management brokering system development (Männik et al., 2011). Estonia has become a knowledge-based society where the creation of new knowledge and the capacity to accept and implement it are the sources of an increase in the quality of life. Research and development and innovation, supported by a flexible and future-oriented education system, are the promoters of society's development. Being a small country, Estonia has to make choices and therefore, the emphasis in both research as well as entrepreneurship is on high quality and/or high added value areas. The connections between research and society ensure the broad dissemination of knowledge encompassing also knowledge and innovative applications created elsewhere in the world, which is particularly important for increasing competitiveness (Estonian Ministry of Education and Research, 2011).

Estonian research and development and innovation (R&D&I) strategy 2007–2013 “Knowledge-based Estonia” focuses on sustainable development of society by means of research and development, and innovation. The Strategy sets out three main objectives:

- competitive quality and increased intensity of research and development;
- innovative enterprises creating new value in the global economy;
- innovation friendly society aimed at a long-term development.

Tallinn has always been a city full of innovation - so the capital of Estonia and the birth place of Skype will host the European Innovation Academy which will take place for the first time in Tallinn. The European Innovation Academy will provide a platform to learn and try out innovation management in an entrepreneurial way. The Innovation Academy is suitable for Engineering, Science and Business students as well as professionals who are intending to pursue a career in innovative management.

4.2 The Industry-Enterprise relationship and real activities for Research Brokering in Estonia

Founded in 1918, the Tallinn University of Technology (TUT) today accommodates 14,000 students, 2,087 employees, 1,125 persons on the academic staff, and 142 professors. About 800 students come from other countries, 5% of the total.

Its mission is to create synergy of technology and exact, natural, health and social sciences for the development of society. It leads the University to conduct fundamental and applied research at international level in developing high-tech applications in the following areas: Civil Engineering; Power Engineering; Information and Communication Technology; Chemistry and Biotechnology; Environment; Mathematics and Physics; Material Sciences and Technology; Social Sciences (including Economics); Health; Production Technologies; Mechanical and Instrumental Engineering.

The TUT mission is to create and mediate values that ensure Estonia's development in the globalising world. Committed to its mission, TUT fosters

research, academic and applied higher education and technical culture and creates synergy between the different sciences to promote societal development.

TUT collaborates with research centres and universities from all over the world and is actually the most international organisation in Estonia.

The vision of TUT regarding internationalisation and innovation with projection to 2015 is “iTUT - top science in companies!” and will be recognised as a motor of economic development and innovation in Tallinn and nationwide.

As its vision to 2020, TUT will be a leading university of technology in the Baltic Sea Region and an active partner of co-operation networks of entrepreneurship and public institutions.

The TUT Innovation and Business Centre was established in 2011. Its goals are “Research”, “Study” and “Innovation”.

The Federation of Estonian Engineering Industry (EML) is a non-profit organisation that on the basis of voluntary membership unites corporations involved in metal-working, engineering and electronics manufacturing, research and technical design institutions and other organisations related to this sector. Established in 1991, today it represents over a hundred enterprises and provides services for activities and capacities of production and subcontracting, arranges consultation, meetings, seminars and visits, compiles and distributes informing materials for advertising (catalogues, CDs etc.). Very important is its close cooperation with Tallinn University, Tallinn College of Engineering and Vocational Centres in the fields of Research, Development and Training.

The curriculum development projects have worked as integrators, making people from industry and university meet and discuss needed skills and knowledge. The Design and Engineering curriculum was created as a result, for example, combining industrial design with conventional engineering, preparing the ground for the next step.

MEKTORY (Modern Estonian Knowledge Transfer for You) was initiated by the Tallinn University of Technology - Innovation and Business Centre and the current partner universities, the Estonian Academy of Arts and the Tallinn University of Applied Sciences.

Mektory is an interdisciplinary innovation platform – a joint platform between universities, where students supervised by the teaching staff come together to put their knowledge into practice in order to create prototypes and launch start-ups. Mektory is focused mainly on practical science projects. It has the following goals:

- to support the innovation and development of TUT (institutes of higher education) as practically as possible – to get round to prototypes
- to support the emergence of start-ups
- to keep talent at university – the students do not go to work but stay to get their academic degrees
- to create frequent cooperation with international innovation platforms
- to be an acknowledged R&D partner for enterprises all over the world.

Three Mektorys, each with a different focus were launched simultaneously in Estonia:

- Mektory of Design and Product Development;

- Mektory of Mobile Services & Media;
- Mektory of Business, i.e. Business Model Mektory.

Over the last 10 years socio-economic development in Estonia has been impressive, and Estonia has almost caught up with the EU innovation leaders (Männik et al., 2011). Starting from a catch-up position in 2001, Estonia has continuously invested in innovation activities and reached the position of innovation followers by 2011.

According to Statistics Estonia, the data of the Innovation Survey show that 56.8% of enterprises were innovative in 2010. The innovativeness of enterprises remained at the level of 2008, when innovative enterprises accounted for 56.4% (Heinlo, 2012).

An enterprise was considered innovative if during the previous three years it had introduced to the market a new or significantly improved product, implemented a new or significantly improved process, organizational or marketing innovation or had expenditure on activities specifically undertaken to develop and/or implement a product or process innovation (see Figure 4.1).

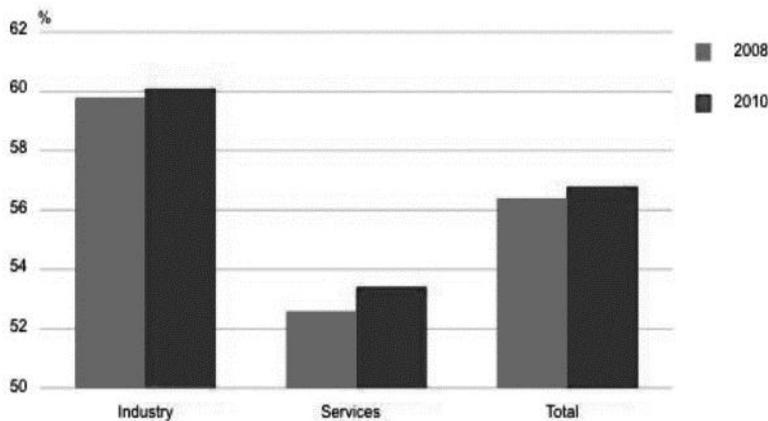


Figure 4.1 Share of innovative enterprises, 2008–2010

Source: Heinlo, 2012

The innovation index for Estonia, based on data from 2009 published in March 2010, is higher than the average index for the 27 EU Member States.

4.3 Nature of Innovation Brokering

While innovation platforms can provide access to innovative ideas, inventions, new knowledge and experts, the innovation process is actually a company-centred activity. According to (Brand, 1998), for an innovation to take place a company needs people

who are willing to share and creative people who have the ability to turn ideas into real products and services. The knowledge management approach provides guidelines on how to empower the various processes of knowledge generation, use, transformation and sharing, both inside and outside the company. Du Plessis (2007) defines the following benefits which KM brings to the innovation process:

- KM facilitates collaboration in the innovation process;
- KM enables the flow of knowledge used in the innovation process;
- KM provides platforms, tools and processes to ensure integration of an organization's knowledge base;
- KM assists in identifying gaps in the knowledge base and provides processes to fill the gaps in order to aid innovation;
- KM assists in building competences required in the innovation process;
- KM assists in steady growth of the knowledge base through gathering and capturing of explicit and tacit knowledge;
- KM provides a knowledge-driven culture within which innovations can be incubated.

4.4 Innovation Capacity

The European Commission calculates the innovation index based on 29 different criteria, which include human resources, financing and support, investments, entrepreneurship, innovators, and economic effects. The main ones are shown in Figure 4.2.

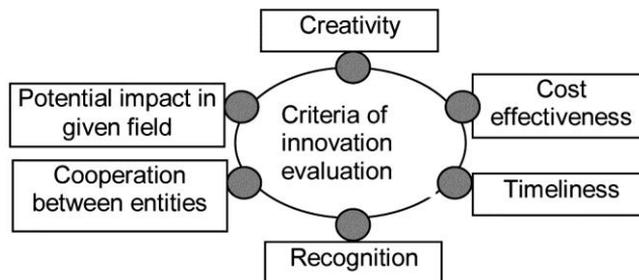


Figure 4.2 Main criteria of innovation evaluation

Innovations will be evaluated by each of the following criterion, in descending order of importance (BAFF, 2012):

Creativity: The innovation should be as original as possible, or the adaptation should be creative.

Impact: The innovation should have a clear or potential impact in its given field; and/or there is evidence that the innovation will contribute to a more efficient way of doing things.

Collaboration: The innovation successfully demonstrates collaboration and cooperation between individuals or entities.

Timeliness: The innovation should not be more than five years old.

Recognition: The results of the innovation have been recognized by peers, critics, or in professional journals; or have demonstrated success in the market place.

Cost effectiveness: There is evidence that the innovation adds value while at the same time containing or reducing costs.

A number of questions remain unanswered when it comes to how everyday innovation capacity may be improved. What mechanism will facilitate the search for information? Who will coordinate the networks of interaction needed for innovation (Klerkx et al., 2009)?

A recent study by the World Bank (2006) found that even when there were strong market incentives for members to collaborate for innovation, linkage formation was still extremely limited. While this suggests that an important role of public policy should be to promote these linkages, how can this be achieved in practice? Is there a need for an organization with a brokering role to help coordinate multiple players and facilitate partnerships and linkages? Should this be a private organization or a public agency?

4.5 The broker's role

Brokers are necessary to bring partners together, motivate them, provide information, and organize space for negotiations. In other words, their role is neither involved in the creation of knowledge nor in its use in innovation, but it binds together the various elements of an innovation system and ensures that demands are articulated to suppliers, that partners connect, and that information flows and learning occurs.

These systemic intermediaries play a role as innovation brokers, whose main purpose is to build appropriate linkages in innovation systems, and facilitate multi-stakeholder interaction in innovation (Leeuwis and Van den Ban, 2004; Sulaiman et al., 2005). National governments and development assistance agencies now face the difficult task of identifying appropriate mechanisms that can play this innovation broker role in the context of dynamic and evolving contemporary methods, in which numerous challenges need to be addressed simultaneously (Hall, 2008). Intermediary organizations, which sit between and connect different agents involved in innovation trajectories are important as they fulfil boundary work (Kristjanson et al., 2009) and play a role in 'bridging', 'bonding' and 'linking' social capital (Wennink and Schrader, 2007), see Figure 4.3.

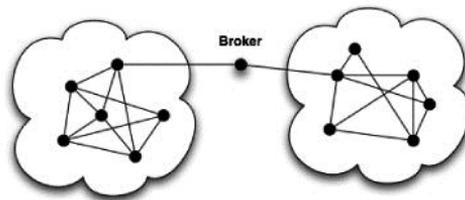


Figure 4.3 Role of innovation brokers

Brokering involves a range of different practices: the identification and localization of knowledge, the redistribution and dissemination of knowledge, and the rescaling and transformation of this knowledge. Brokering knowledge thus means far more than simply moving knowledge - it also means transforming knowledge (Meyer, 2010). In the case of knowledge brokering, this collective exploration is based on two key movements. On one hand, there is a translation of knowledge from one world to another. On the other hand, we see efforts to make knowledge socially, politically, and/or economically robust. The end result of these translations is the production of a new kind of knowledge - what we could call brokered knowledge.

4.6 Innovation process management

It has been confirmed that innovation process management is an important function that can be performed by innovation brokers. Innovation processes tend to involve different groups of actors, who have different expectations and interests, see Figure 4.

1. An internal broker being someone from one or other of the partner organizations carrying the process management role over a period of time by agreement with the partner group;
2. An external broker being brought in to undertake specific tasks – for example, to be a ‘neutral’ facilitator of a series of workshops / meetings or to undertake a partnership review on a regular basis.

Brokers are increasingly seen as playing a critical part in effective multi-sector partnering. The brokering role consists of taking responsibility for building robust working relationships between the partners; ensuring that the partnership is innovative, appropriate and effective as well as encouraging the partners to achieve maximum positive impact with a focus on sustainable outcomes.

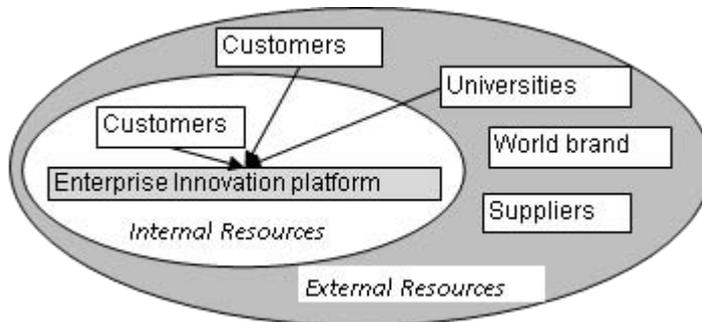


Figure 4.4 Enterprise knowledge transfer and absorption

A broker translates knowledge created in one group into the language of another so that the new group can integrate it into its cognitive portfolio. To do this, brokers must be able to manage the relations between individuals as well as act as translators. The broker's role is a delicate balancing act. To be effective brokers need to have authority within all the groups to which they belong. They need to be able to evaluate the knowledge produced by the different groups and earn the trust and respect of the various parties involved (Kimble et al., 2010). Over time, the broker's activities may lead to the development of a repertoire of shared resources such as rules, procedures and the boundary objects used by the group.

Innovation networks appear to bring more globalization into being. Cooperative innovation creates complex and overlapping networks that shape global markets, provide intelligence about innovation opportunities around the world, and serve as the organizational base for acquiring relevant knowledge and expertise wherever it is located (Petit and Soete, 1999).

Large organizations are made up of many of these self-contained teams, each with their own shared experiences, ideas and ways of doing things. Brokerage is the act of bridging the gaps, or filling structural holes, between these groups in the network. People who have connections with multiple groups that would otherwise be unconnected are known as brokers or bridges.

4.7 Case Study

Enterprise Estonia (EAS), established in 2000, promotes business and regional development in Estonia. Enterprise Estonia is one of the largest institutions within the national support system for entrepreneurship, providing financial assistance, advice, cooperation opportunities and training for entrepreneurs, research establishments, public and third sector (see Figure 4.5).

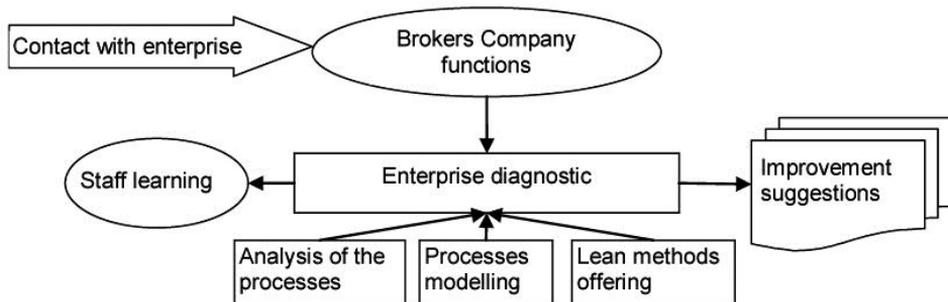


Figure 4.5 Enterprise Estonia (EAS) functional scheme

Enterprise Estonia operates in the following areas:

- increased sustainability and accelerated growth of start-up companies;
- improved export and product development capability of Estonian companies;
- greater impact of foreign direct investments on the Estonian economy;
- increased tourism export and the development of domestic tourism;
- promotion of regional development and civil society.

After the accession of Estonia to the European Union, Enterprise Estonia became one of the implementing units of the European Union structural funds in Estonia. Today, most of the EAS programmes and grants offered are co-financed by the EU structural funds. In the 2007-2013 financing period of the European Union 830 million Euros out of more than 3.4 billion for structural assistance for Estonia, will be applied by Enterprise Estonia.

The area of company development involves several direct supports as well as information programmes, part of which sets clear restrictions for the company's field of activity and part of which is meant for the really wide target group. The more limited sectors are for example the supporting of technology investments by industrial entrepreneurs and development of a creative industry. At the same time management quality development should be of interest for each entrepreneur.

One of the directly supported programmes is for production management consulting aimed at increasing company efficiency and productivity which was launched in 2011 after a few pilot projects in 2010 that were very successful. A simplified scheme showing the parties involved and their purpose is presented in Figure 4.6.

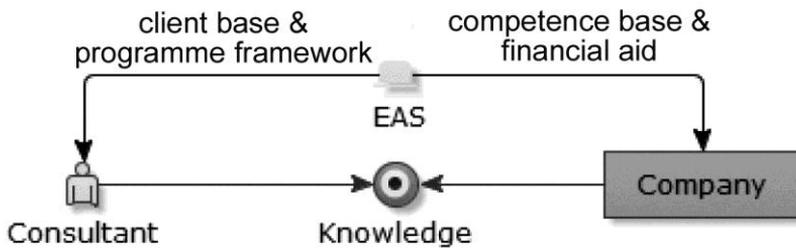


Figure 4.6 Parties involved in brokering

The uniqueness of this programme is in 3-party joint efforts: EAS, Company and independent consultant with extensive experience in production management and deep theoretical knowledge.

For historical reasons production companies in Estonia are not used to asking for help from outside consultants, which is a common way of getting competence for a short term and/or focused area of knowledge in, for example, Scandinavian countries. However, due to the rapid growth of the Estonian economy a gap appeared between demand and availability of high level specialists in the areas of production and technology management. Due to such imbalance in quality consulting there were cases where companies were not satisfied with received consulting services due to lack of competence on the consultant's side or due to misunderstanding of what consulting is and how it is carried out. Such situation resulted in lack of trust towards external competence in principle.

At the same time small and medium-size companies were caught in a trap as they could not afford to purchase services provided by consultants from abroad due to the high cost. In addition, consultants from abroad may not know specifics of local regulations. Yet another complication is a language barrier that is almost impossible to overcome while working in the area of production management, as local workshop labour only speaks Estonian or Russian or both, while consultants from abroad do not speak either of them. Thus a translator is needed and this increases the cost and risk of misunderstanding during consulting. Such a language barrier only allows provision of consulting for company management.

Understanding the situation, EAS has decided to act as a "bridge" between companies and consultants, responsible for background and professionalism of consultants on one side and as guarantor that consultant services will be paid for correctly by the company. Source:

In 2011 EAS selected specialists with backgrounds in production management and gave them internal training to guarantee a solid level of competence. Each consultant's background was checked extensively and a cross-referenced competence matrix was developed to map areas of expertise that EAS can provide to companies. Areas are listed in Table 4.1.

Table 4.1 Strategic areas of expertise

Strategic business planning	Change management
Manufacturing strategy	Supply chain management
Process management and improvement	Quality Assurance, TQM
5S	ISO9001
Lean production – concepts	ISO14001
Lean office	ISO18001
Equipment layout	EFQM model
7 Wastes	Information technology
Value Stream Mapping	Production planning and control
Set-up time reduction	ERP/MRP
Kaizen - continuous improvement	CAD - design and development
Total Productive Maintenance	Equipment selection
QCD measures	Project management
Organizational structure changes	Energy management
Cultural change	

Source: EAS, 2011

A generic programme scheme is shown in Figure 4.7.

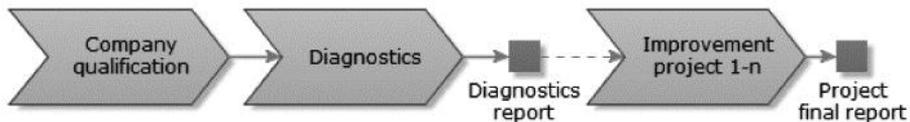


Figure 4.7 Brokering programme implementation in Estonia

Source: www.eas.ee/et/ettevotjale/ettevotte-arendamine/toeostusettevotja-noustamise-toetus/ueldist

Prior to the launch of any improvement activity, areas of the utmost importance for the company must be identified. A consultant who carries out production diagnostics lists various improvement possibilities in order of importance and feasibility. According to these possibilities improvement projects can be launched later on. An overview of Diagnostics and Improvement processes with current results is shown in Figures 4.8, 4.9 and 4.10.

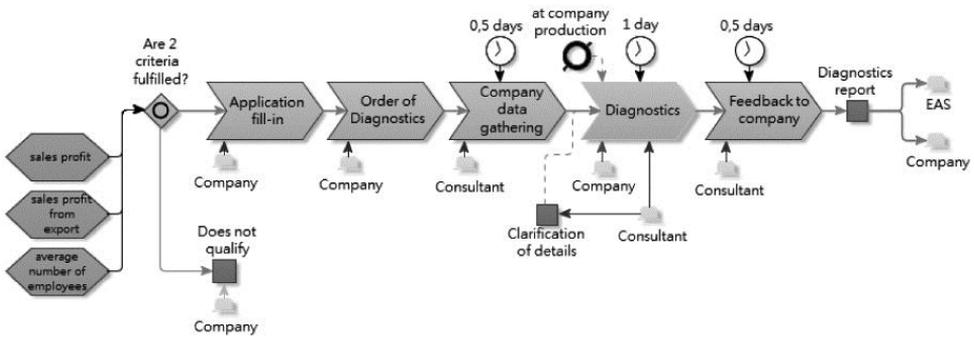


Figure 4.8 Company diagnostics process

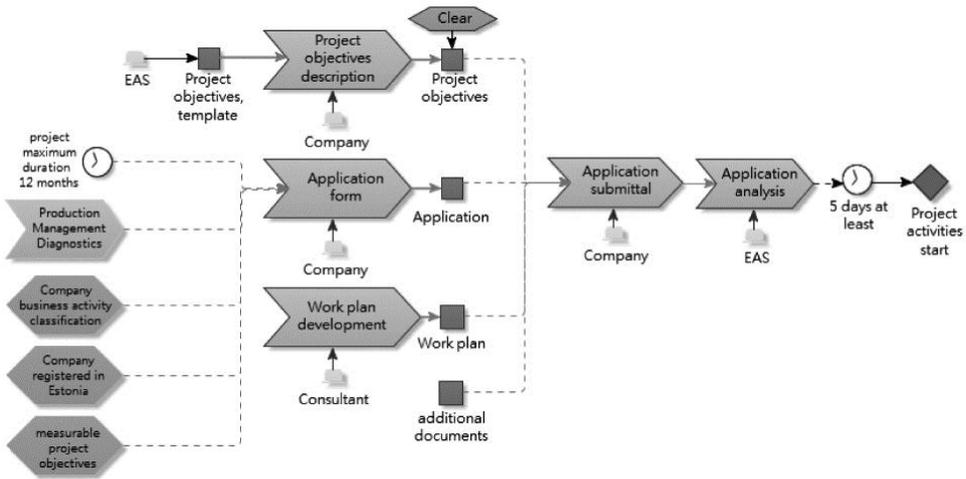


Figure 4.9 Overview of Improvement Project process

Source: www.eas.ee/et/ettevojale/ettevotte-arendamine/toeostusettevotja-noustamise-toetus/ueldist

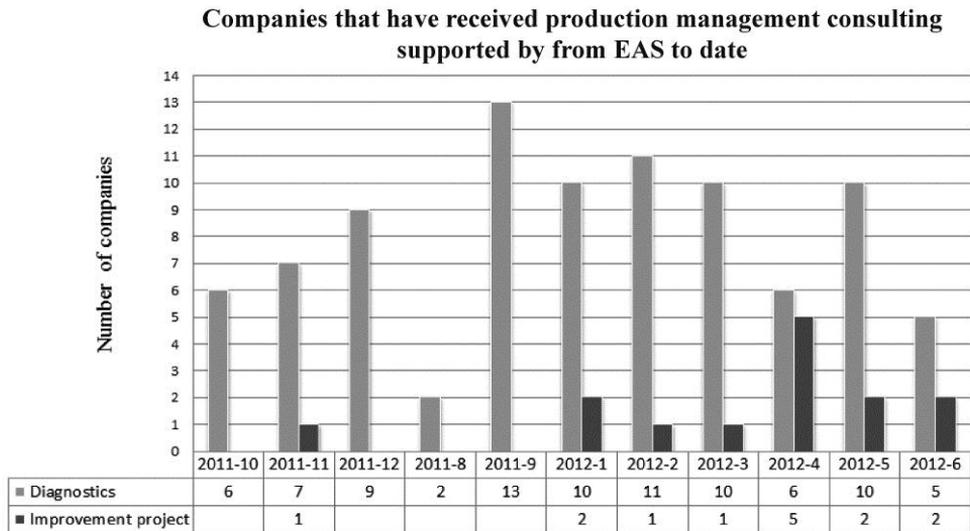


Figure 4.10 Programme results as of May 2012

Source: www.eas.ee/et/eas/sihtasutusest/toetatud-projektid/toetatud-projektid-alates-2004a-aprill?page=0&pageitems=25&display=1&company_name=&project_year=2012&county=&schema=1405010P&view=listprojects&sortby=project_date&sortdir=asc

Overall it is visible that companies are rather keen on ordering Diagnostics services that are sponsored by EAS, but are not so keen on starting Implementation Projects, even if EAS is meeting up to 50% of consultancy costs. It can be seen that companies are still in the “getting used to” phase with regard to consultancy services. To promote successful projects EAS has arranged public presentations through various events focused on the industry, where a company representative and a consultant together present improvement projects and their results, as well as share experience about programmes and working with consultants. The latest major event that gathered around 300 participants was held in May 2012 where a door manufacturer’s recent project was presented, receiving very positive feedback. Unfortunately, since by definition of the support programme in question improvement projects are highly important and sensitive for the companies, presentation material and project contents are not available for public use.

4.8 Conclusion

Information and communication technologies provide multiple opportunities to enhance and improve existing business models and processes. KM allows business processes to become more efficient and effective by ensuring better redistribution of

the organizational resources and better response to the signals coming from the business environment. One independent Innovation platform will enhance the organizational innovation processes and will contribute to better exploitation and use of organizational knowledge management by improving the innovation and knowledge management processes within an organization.

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5

Open Innovation networks and Innovation audit experiences

This chapter describes the Open Innovation networks in three European regions. Within the networks, the Research-based competence broker was observed in action through Innovation audits in small and medium enterprises. Consequently, the organisations and the brokers involved provided feedback about the main profile actions and competences. In particular, paragraphs 5.1 and 5.2 present the networks and perspectives drawn from the interventions in Italy, paragraph 5.3 shows the outcomes achieved in Germany, paragraph 5.4 includes the results of a survey and the action among SMEs in Southern Switzerland, together with the implications for profile training.

5.1 Innovation and competitiveness: a Triple Helix challenge

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Innovation is a broad concept, both in scientific and academic discussions. In a company perspective, it is possible to identify two main dimensions: subject (product, process, business model) and nature (incremental or radical). Within innovation enablers, new technologies as well as the shift to new business models and sustainability challenges (Nidumolu, Prahalad and Rangaswami, 2009) are an increasingly powerful driving force. Nonetheless, their complexity often goes beyond the capabilities of individual companies (Vanhaverbeke and Cloudt, 2005). Particularly in the case of the Veneto region, where the economy features a high rate of SMEs in mature sectors, insourcing of externally developed technologies is crucial for the innovativeness of a company. As highlighted in the previous chapters, the broker's role surely contributes to "a heightened awareness of the possibilities and

potential of the SMEs' demand for research", within a regional development perspective (see Chapter 1).

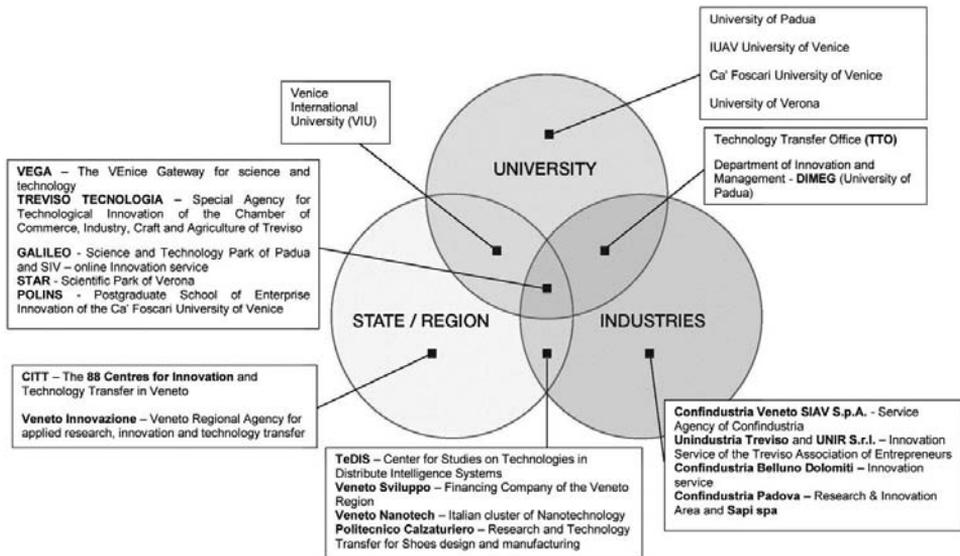


Figure 5.1 Regional system of relationships among Industry-University-State

In order to enhance the potential of the concept developed in Norway, and informally applied also in other countries across the European Union, within the Rebasng project, Confindustria Veneto SIAV analysed the existing local environment for innovation by describing it through a Triple Helix perspective (Figure 5.1). As a matter of fact, among other non-technology enablers, public policy and funding as well as strategic and operational management play a significant role in its successful adoption (UK Technology Strategy Board, 2012).

Although Figure 5.1 cannot possibly include an exhaustive list of the bodies, agencies and research centres supporting innovation in business at regional level, it leads to two main remarks. Firstly, the lack of a strong cohesive policy among the players increases the barriers to R&D access by firms. Secondly, R&D opportunities also lie outside the regional system, while the current network does not (yet) support companies' resilience in highly dispersed value chains.

Among other challenges, regional companies have to face their condemnation to continuous innovation and consider the issue of their business continuity (Brunetti, 2012), while public policies are held responsible for the low attractiveness of foreign direct investments as well as for unsatisfactory investments in infrastructure (Costa, 2012). These aspects also influence the level and quality of the human capital competences available at regional level.

Additionally to structural weaknesses, the long-lasting impact of the crisis on manufacturing, or even the slow shift to a new paradigm in markets, limited the mainstay of innovation without research, considered to be the pillar of local SMEs development, based on a systems-theory recombination of innovation generated elsewhere (Moncada, Paternò, Castello et al., 2006).

On the one hand, the highlighted issues might hinder the institutional legitimacy of the broker's role in supporting innovation in companies, on the other hand the field test showed the potential of as well as the need for such a profile.

Within this perspective, the aim of Confindustria Veneto SIAV (SIAV) was to validate the process described in Chapter 2, as well as validate the Broker profile at EU level while highlighting specific local features. The medium-term objective is the introduction at regional level of the broker tool and consequent support for the development of competences in dedicated human resources. As SIAV is the Service Agency of the Manufacturers Association in the Veneto region (Italy), this action aims to strengthen innovation skills in an Open Innovation context in order to support companies' competitiveness.

5.1.1 A tool for innovation: the competence broker

The aim was to select a competence broker, and provide him/her with the tools and methodologies to carry out an innovation audit. On the basis of on-the-field observation, her/his profile was checked against the one drawn at partnership level, while specific features were highlighted through the innovation audit description.

In fact, broker actions are proved to be effective when she/he masters a thorough knowledge of the regional economic context.

The selection of brokers.

Brokers were selected on the basis of specific regional criteria, in order to highlight possible additional national, sector or local competences necessary to support innovation in the identified Open Innovation network.

The criteria applied were set in consideration of a literature and case studies analysis (see Chapter 2 and 3):

- type of organisation: legal status, role;
- broker's field of expertise: technical and non-technical skills;
- gender and experience: to identify the influence of experience in terms of competences, while ensuring the involvement of under-represented gender.

Accordingly, SIAV selected three brokers, whose characteristics are described in Table 5.1.

Table 5.1 Selected brokers

	<i>Type of organisation</i>	<i>Role</i>	<i>Field of expertise</i>	<i>Gender/ experience</i>
<i>Broker A</i>	<i>Private organisation, experts cabinet</i>	<i>Owner/ Entrepreneur</i>	<i>Environmental impact, energy efficiency</i>	<i>Female, senior</i>
<i>Broker B</i>	<i>Private organisation, experts cabinet</i>	<i>Employee in charge of energy audit and certification</i>	<i>Environmental engineering, energy efficiency</i>	<i>Female, junior</i>
<i>Broker C</i>	<i>Private organisation, association of manufacturers at provincial level</i>	<i>Head of innovation service</i>	<i>Connection among R&D centres and companies, organisation</i>	<i>Male, senior</i>

Although Brokers A and B work also as consultants in the field of energy certification, they provide a brokering service to companies to support green product and process development. Their “hard” competences are mainly connected to sustainability challenges. The term “Junior” refers to their experience in the role of broker. In fact, Broker B has already acquired extensive experience in her field in a multi-utility. Nonetheless, they performed the innovation audit in pairs, as some specific knowledge and some competences were not yet fully mastered by the Junior broker, namely:

- communication competences: how to ensure a trustful relationship with the company management or owner;
- insight into possible commercial opportunities of the innovation sought.

Broker C (included in the case studies presented in Chapter 2) specifically provides a service to connect firms and R&D centres in compliance with the mission of Confindustria Belluno Dolomiti, the provincial Association of entrepreneurs in North-eastern Italy. The service is coordinated with other initiatives of the Association i.e. Training, Internationalization.

The innovation audit: focus and tools.

Following a review of the existing network and the ongoing activities to foster Knowledge & Innovation in companies, SIAV identified the core of the brokers’ intervention on four companies at local level. They carried out an innovation audit in each of them.

The brokers undertook the intervention process previously described and applied the tools provided by the partnership. Supported by SIAV, they proceeded to the definition of their Open innovation network through Triple Helix visualization, Innovation Audit reporting tool, list of selected tools and methodologies.

Two of the audits were focused on the introduction of “green” innovation concepts and the identification of suitable research and development activities in the companies. Both were performed by brokers A and B, in order to facilitate the acquisition of competences by the Junior one.

The approach adopted was mainly company pull: on the one hand SIAV identified a group of companies interested in green innovation issues, on the other hand, the brokers actively offered their support.

The brokers assessed technological innovation needs (product/process oriented) and the related resources. An Action Plan/Road map to support the company was based on the Audit results.

The third audit highlighted the networking role of broker C as well as his ability to gain insights into company’s needs. The company contacted the broker and the Innovation Service provided several training initiatives carried out by the Confindustria association. No specific request was addressed to the broker, but several “innovation dreams” were shared during informal meetings. The actions undertaken from October 2011 to May 2012 identified the source of innovation and the resources needed to begin an innovation development process within the company. On the basis of the Innovation Service approach, the broker supported the company until definition of the proposed project.

During the fourth audit, the broker facilitated the identification of the knowledge provider centre able to solve a micro-welding problem in eyewear manufacturing. The approach adopted was a mix of company pull and push: the company was interested in the Innovation service provided by Confindustria Belluno, and the broker built a trust relationship and proposed information and exchange opportunities to the company.

5.1.2 The broker’s competences: remarks and perspectives

The innovation audits allowed SIAV to check the brokers’ competences on-the field and to identify sustainable opportunities at regional level.

Figures 5.2 and 5.3 show the “ecosystem” of competences of the brokers involved. The three axes consider the growing availability of broker competences in relation to the main focus of her/his activities. To foster innovation in a firm, the broker may contribute to:

- technical knowledge generation and acquisition, depending on her/his strongest technical competences;
- introduction/improvement of organizational features or process-oriented methodology;
- create/ support connections and facilitate relationships among R&D centres and firms.

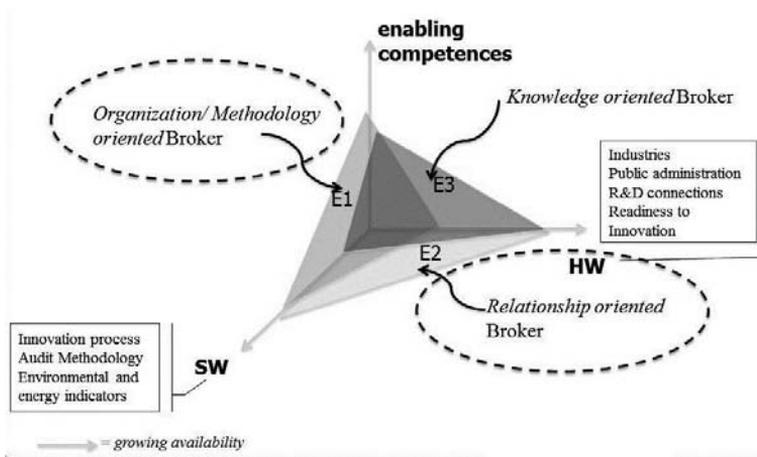


Figure 5.2 Ecosystem of competences: brokers A and B

Figure 5.2 shows how brokers A and B mainly acted to facilitate the introduction of new methodology in the firms. They also proposed a range of research centres to involve in new service/product development, respectively to the firms' sectors (ICT services vs. house appliance manufacturing), thus performing a connection activity.

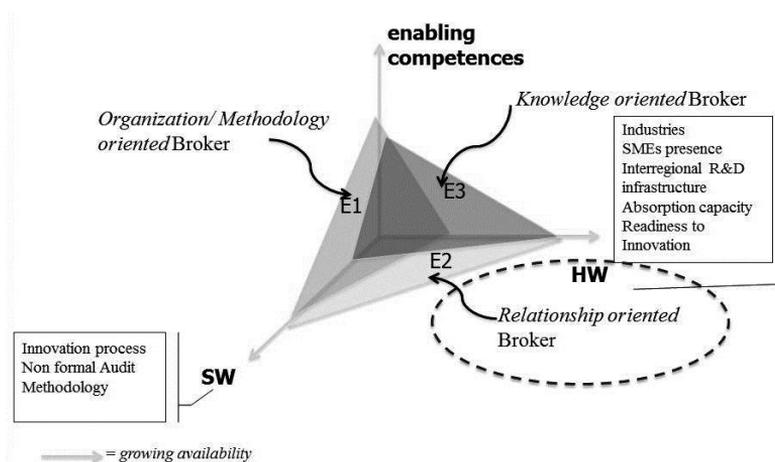


Figure 5.3 Ecosystem of competences: brokers C

Figure 5.3 presents the focus of the broker as a main connector among R&D providers and firms.

Broker C's major activity is the creation of connections with research centres, in order to create successful relationships between firms' needs and research expertise.

- The broker is no "superman"; the overall profile proposed in Chapter 6 describes team competences. Actually each broker shows different levels of mastery, responsibility and autonomy of the identified competences.
- Some sound technical knowledge (i.e., engineering and/or scientific-based subjects) speed up the identification of needs. Its cross-sector application may widen the innovation perspectives of the firms involved, particularly within a sustainable innovation perspective.
- The broker competences are mostly developed through experience and continuous relationship with firms, within an innovation process.
- The activities performed are more successful when the broker constantly enlarges and enriches the network of R&D providers, while updating her/his knowledge about available funding opportunities for research.
- With regard to regional features, the brokers in Veneto region do not include direct management in their activities nor do they have a sound knowledge of Intellectual Property Rights. In fact, in consideration of the national regulations IPRs-related issues typically involve other job profiles.

With reference to EU profile Research-based Competence Brokering proposed in Chapter 6, the validation was enhanced by a self-evaluation from all the brokers involved in Rebasing project activities. Although the sample is not a statistical one the results clearly highlight that there are only minor national differentiations among competences possessed.

5.2 Innovation brokering in Treviso Tecnologia

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Treviso Tecnologia, and in particular its Innovation Projects Development (IPD) department, provides specific support actions to companies in the framework of the Open Innovation concept:

- Preparation of projects to participate in EU/national/regional calls for proposals (access to public funds);
- Technology auditing;
- Innovation auditing.

Service delivery is targeted at all kinds of companies (of all industrial sectors and sizes), although SMEs are the main focus, also in the light of Treviso Tecnologia's mission as the Special Agency for Innovation of the Chamber of Commerce:

- **SMEs:** support in raising awareness of Innovation issues and finding funding tools to implement Innovation projects, as SMEs usually do not have enough financial capacity to launch and manage R&D projects on their own;

- **Large companies:** provision of professional services for specific projects where the company has the financial capacity, and a dedicated budget, to sustain them.

Treviso Tecnologia acts in three typical Open Innovation network scenarios:

1. **Methodology:** in order to raise a company's awareness of its organizational structure, Innovation management and Innovation driven strategy design (aimed at sustaining the development of a network);
2. **Network:** to further develop an enterprise's Innovation Strategy towards external partners, also from other sectors (exploitation actions);
3. **Transfer of Technology:** in the further development of a company's Innovation Strategy, to build awareness of the importance of external relations (Open Innovation paradigm) and its strategic management. Moreover, mostly in big companies, to enhance the importance of Intellectual Property Rights.

As the added value of effective Innovation brokering actions lies in the quality of the Open Innovation network, Treviso Tecnologia focuses on particular efforts in establishing several relationships with diverse actors belonging to the Triple Helix:

Universities

- IUAV University of Venice (design department);
- University of Padua (computer studies, mechanical engineering, psychology, materials engineering);
- University of Trento (mechatronics);
- University of Venice (ICT, chemistry);
- Polytechnic of Milan (materials, process, mechanic, ICT).

R&D (national and European) Centres

- CNR (National Research Council);
- Cineca (Consortium of Universities);
- ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development);
- Centro Ricerche Fiat;
- Fraunhofer Institutes;
- Stazione Sperimentale del Vetro;
- Philips Research;
- TNO (Netherlands Organisation for Applied Scientific Research).

Moreover, there is a wide network of consultants chosen for their particular expertise.

Treviso Tecnologia pays a lot of attention to selecting the right actors to involve in order to build strong, concrete relationships focused on specific contents and aims.

The relations are both formal and informal: formal connections are usually regulated by ad hoc agreements and defined with Universities, R&D Centres; informal relations are mainly referred to consultants.

The IPD department, composed of three Junior Brokers from different backgrounds (Social Psychology, Economics) led by a Senior Broker (degree in Computer Science), focuses its efforts on fostering continuous development and sustainment of a Triple Helix network that can give effective answers to companies' needs in terms of (Open) Innovation. It does this by "activating" the right parts of the

network, providing information and facilitating effective contact between companies and selected third parties. Particular care and attention are dedicated to building a strong relationship also with the companies involved, based on trust and customer retention, which is first of all a key element for a successful Innovation Audit, and then for effective Innovation project development and implementation.

Team-work is crucial as contacts with companies (i.e. entrepreneurs, technical directors and R&D managers) are kept by different representatives of the group (IPD) that share and discuss the outcomes of the audits, etc. The Senior Broker endeavours to discuss openly with the working group in order to have others listen to the discussion and even if not directly involved, “actively aware” of the company. This facilitates not only the information flow (from junior to senior and vice versa) but also the sharing of information among the group and possible cross-discussion.

5.2.1 The Innovation auditing experience

The objectives of Treviso Tecnologia were basically set at three different levels, in the framework of the Innovation Audits performed within the Rebasing Project. On the one hand, to strengthen the relationship with a company already involved in some service provision, in terms of defining a path/project in the framework of the Open Innovation issue; on the other hand, to explore the possibility of involving a service company, usually not targeted by the professional services managed by the IPD department. Finally, to validate the Innovation Broker EU Profile developed and defined within the Project. In the first context the Junior Broker in charge of managing the Innovation Audit was a member of the IPD who had already met and got to know the company when providing internal professional services about virtual prototyping. These previous relations were important with a view to performing the Innovation Audit in a positive and open environment, in order to focus directly on critical issues about Open Innovation within the company and directly investigate the possible areas of intervention. In this case the Junior Broker focused mainly on the Network development and Transfer of Technology areas. In the second context, with a view to creating relationships with service companies, a Junior Broker who comes from the Training and Counselling Services department of Treviso Tecnologia (degree in Social Psychology) and knows the peculiarities of this type of organization, was chosen. In this case, a relevant part of the Innovation Audit was dedicated to clarifying the Innovation and Open Innovation concepts, at the same time paying particular attention to capturing the openness, propensity and potential of Innovation, so as to provide “acceptable” proposals to the company. Here the Junior Broker mainly focused on the Methodology area.

It is always difficult to describe a competence so complicated and characterized by many soft skills that can only be gained over many years of practice. However, it was quite clear that some general competences should be detected and transferred to Junior profiles. At least knowledge or hands-on learning about:

- management of complex situations (savoir-faire attitude, rule compliance);
- interpersonal relations (intra-office; with external parties, dialogue, listening approach);

- IT tools competence (e.g. web search, 2.0);
- focus oriented approach (come to the point, avoid effort dispersion).

Technical competence comes from different expertise and professional opportunities, so each member of the working group might have different paths. Coaching is oriented more to the four above-mentioned points rather than dealing thoroughly with technical matters.

Referring to specific tools and methodologies applied during the Innovation Audits performed, but also to other Audits that the Treviso Tecnologia Brokers usually do, it is to be pointed out that the first meeting with a company consists of a sort of “personal talk” at different levels of depth which is strictly connected to the quality of the relationship established by the Broker with the company. A complete Audit is composed of different steps focused on dealing more deeply with specific issues and technicalities, step by step. Setting up a relationship based on trust is essential to build an environment suitable for successfully implementing a path to Innovation, and this requires more attention to a balanced use of soft skills than to specific tools, which could be applied in a second phase when the company’s commitment is effectively captured. During the Innovation Audits carried out within the Rebasing Project, an Audit reporting tool provided by the Partnership was used: before the meeting with the company the Broker carefully checked all the areas which had to be investigated during the Audit, in order to cover all the aspects required. The report was completed later, also by adding the use of other tools (i.e. SWOT analysis).

5.2.2 The EU “Research-based Competence Broker profile”: validation and comments

Going more deeply into the aspect concerning the Broker competences, it must be said that he/she does not act as a consultant. It is important to have some basic knowledge about the company’s sector, type of production process, market, technologies, etc. but just basic notions, in order to use the same language and identify possible areas of intervention. As previously mentioned, one of the key elements is to be able to build a strong connection with the enterprise, based on mutual trust, which leads to the right climate of openness and willingness within the company to be involved in an Innovation project. The real added value brought by the Broker lies in his/her ability to strategically manage his/her own network, constantly widening and enriching it in order to provide the best answer to the company’s needs.

Besides the network, it is very important for a broker to keep an active, and more importantly, curious mind. The latter is the fundamental sense and attitude that a broker should have. It should not be an obsessive, compulsive, frenetic curiosity, it should be soft, smooth and constant. No peaks (a broker should not have a particular ‘love’ for one sector rather than another, by definition he/she is a networker and a network is synonymous of ‘multiple’, ‘diverse’ etc.) and no lows. Of course, after many years, professional life pushes more towards maybe one sector than another but the mentality (curiosity) should always be there.

Referring to the EU “Research-based Competence Broker” profile developed by the Rebasing Partnership, the experiences of the Junior Brokers in dealing with the

Innovation Audits basically confirm the profile scheme, in particular most of the competences related to:

- identification of the company's business strategy;
- implementation of an audit of an enterprises' technological needs in order to identify initial and on-going needs;
- analysis of emerging trends;
- assessment of new technologies and Innovation priority setting;
- planning of a research and development process – project;
- acquisition of investments for a research and development process – project;
- building, maintaining and expanding networks among R&D providers.

Only the competences related to Innovation exploitation and patent protection are not considered part of the Broker profile at local level, as this field requires the very specific expertise of dedicated professionals (i.e., Treviso Tecnologia IP Protection Services department).

5.3 Identification of the Open Innovation network in Saxony

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Figure 5.4 Saxony, Germany

In the region of Saxony (and bordering Free States like Thuringia and Saxony-Anhalt) the majority of companies which endeavour to cooperate in the context of Rebasig project are SMEs or microenterprises. If they have a family-owned structure, the management of most SMEs is just second generation (due to the historical background of Eastern Germany). Furthermore, the cooperating companies are mostly successful, innovative and well-established SMEs, which do not have the resources for independent R&D activity. The region of Zwickau and surroundings operates especially in the automotive engineering and automotive supply industry. The technology and innovation transfer structure in Germany is quite well developed, but the innovation landscape differs from State to State. In Saxony the development of an innovation network has stagnated in the last few years. As the environment is determined by the parties involved, there is potential for improvement of the network in Eastern Germany (since there are many relatively young SMEs). In Zwickau there are fewer convenient structures for broker-managed cooperation; in comparison other Saxon cities do have a favourable infrastructure (e.g. Chemnitz, Bautzen, Dresden and Mittweida). Furthermore, the Saxon economy in general is not aware of the possibility of broker-managed innovation transfer.

According to the latest experience, the major need for innovation refers to material and energy efficiency. The Open Innovation network involves companies, research centres (e.g. Fraunhofer Institute), universities and policy makers. As most of the innovation projects in Germany are funded by the government, policy makers play a significant role in the promotion of innovation transfer projects. In general universities and bigger companies are more inert in generating innovation cooperation than SMEs. In comparison, research centres are more concerned with the economic needs of the market when developing technologies. Besides the traditional cooperation structure of R&D centres and companies, companies may often cooperate among themselves. Therefore, firms in the same industry, but also from different industries, cooperate for innovation development (e.g. also transfer of knowledge in the automotive supply industry in Saxony). The activities can be classified as more informal, as the transfer of innovation and technology is mainly based on trust among the players (especially when SMEs are cooperating).

The core activities of the broker consist of project management activities within the innovation project. This also includes project planning, monitoring and constant support of the different parties. A further major responsibility of the broker refers to the management of product development and assessment of the technology transferred (which also requires technical knowledge on the part of the broker). The broker serves as a connection between the players and has to strive to maintain an essential link. Besides this, the broker deals with research management, competence management, information management, transfer management and network management. Technology transfer in this context is a mixed form of innovation management and cooperation management. According to the experience of the broker and due to the fact that the network mainly consists of owner-operated SMEs, networking activities are the most crucial when trying to promote innovation transfer.

5.3.1 Broker selection and training

There is consensus that a successful broker should definitely have an academic background when engaging in the field of research based brokerage. According to the experience and advice of local brokers, training or possible education should at least include the general technological processes of a company, psychology and basics of law and intellectual property. Since the broker acts as a project manager within the cooperation partnerships of innovation and technology transfer, a sound knowledge of project management is essential as theoretical background. Furthermore, the most suitable course of studies in the local context of Saxony would be Economic Engineering, which includes technical education as well as the economic background for broker's activities. Exceptions are specific business areas and the corresponding transfer projects which require more technical knowledge, e.g. biotechnology. In the course of such projects, a broker should have a degree in these specific studies.

One of the 11 most important universities in Germany, and the only prestigious one in the Eastern part of Germany, is the Dresden University of Technology (Technische Universität Dresden), located in the capital city of Saxony. The range of studies of TU Dresden also offers a combined Bachelor and Master's programme for technology and innovation management. The major courses are technology management and financing, as well as innovation and product management. These courses provide students with the necessary knowledge and practical skills for target-oriented management of innovation processes and prepare them to conceive and implement innovative solutions independently. In particular, the students are prepared for management and controlling tasks in the field of research and development, project management and strategic business planning.

5.3.2 Innovation audits

The research conducted by the German partner was mostly characterized by product innovation and less by process innovation. Of course, this was only a selective analysis without statistical background. Nevertheless, according to the experience of the local brokers, most SMEs are more willing to introduce product innovation, which afterwards requires some process adjustments.

The focus of the first audit lay on the preparation and further development of an innovative renewable energy product. Therefore, the designing engineer's office searched for support not only from companies but also research institutions. The objective of the partnership was introduction of the product to the market and consequently the transfer of the technology and initial idea to the cooperation partners. For the missing theoretical background and due to the limited resources of the local SMEs the cooperation partners provided support. The prototype was created by the SME and after the General Manager had identified the potential usage and commercialization of the product, a search for and selection of possible partners began.

The second project researched involved building up a partnership for the future project. According to the experts' experience, the main focus of innovation projects

has changed to energy and material efficiency over recent years. Therefore, a government funded project aiming at improvements in the use of renewable energy was initiated by several German ministries in spring 2012. “Showcase Electromobility” invites SMEs, research centres, universities and all kinds of companies to participate in the exchange of best practices relating to electro mobility. By involving research and development institutions, new technologies can be introduced to the market relatively quickly.

The research and practical players will gain mutual benefit from the cooperation project, as the best practices of the entrepreneurs will be tested professionally and the research institution can use the information from these testing stages for studies in this field. Therefore, the whole project could be classified as technology transfer among the participating parties.

5.3.3 Tools and methodologies applied

The tools applied during broker activities vary according to the project to be implemented. In the example cases the main difference between the projects is funding, and consequently the project process. Example case 1 is privately funded by the cooperation partners, whereas example case 2 is funded by the German government.

For the brokers in the Zwickau region, networking events are the most crucial methods for the successful building of partner databases. During these networking events, common cooperation partners are invited, as well as new companies which could be interested in cooperation. The main tools used are facilitation, discussion and brainstorming for the introduction of possible new products. Direct marketing is used for the dissemination of these events. If a concrete project is going to be implemented possible cooperation partners are selected by market analyses, as well by analyses of company needs. Afterwards marketing tools (like SWOT analyses, BCG portfolio) are used for the positioning of the different players. Further common tools for the identification of needs and partner compatibility are market research and process analyses. The brokers also have to deal with technology concepts. Communication of the use and results of theoretic constructs is problematic to the more practical engineers in SMEs, as they are not familiar with these theoretic tools. Studies and target-performance comparison can be conducted for the assessment of future usage of product feasibility.

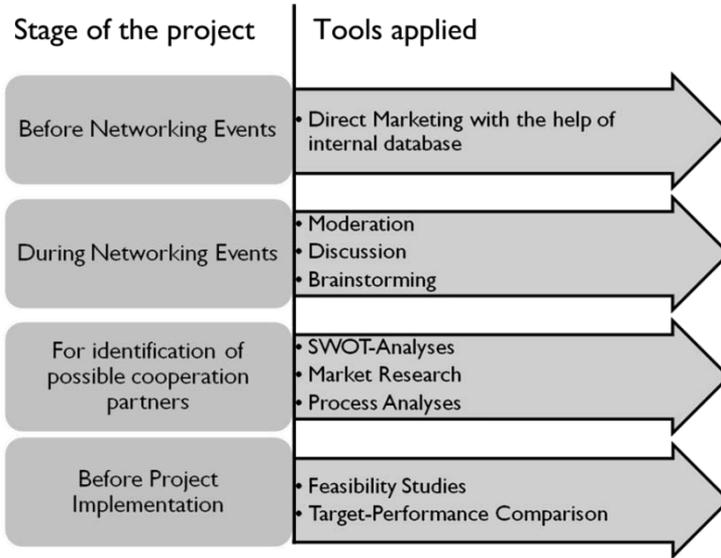


Figure 5.5 Applied tools, audit 1

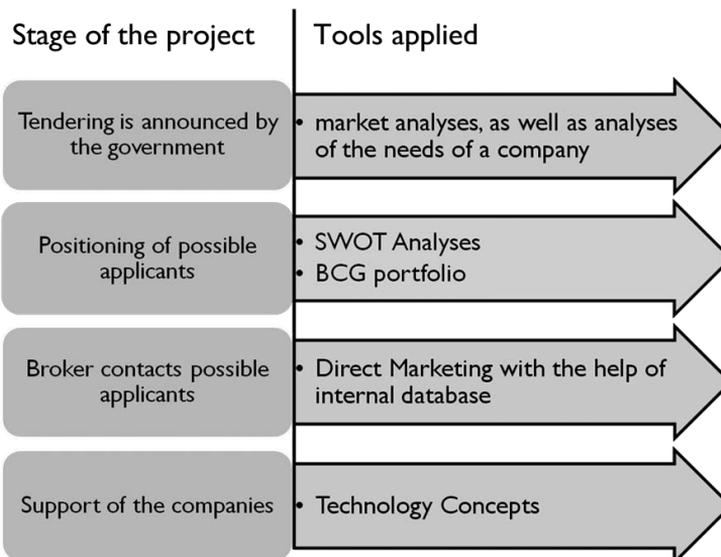


Figure 5.6 Applied tool, audit 2

5.3.4 Feedback concerning broker competences and validation of the EU profile

Through research and brokers' statements it has been concluded that soft skills are more crucial for a successful broker's career than hard skills and professional knowledge. What is to be highlighted is the competence to balance out differences in education, knowledge or even social environment among the various players. Another very useful competence is a sense of tact, especially while dealing with SMEs in more practical fields of business. Nevertheless the perfect mix of hard and soft skills is to be achieved, but in some business areas a broker will need more professional or social intelligence. Further important features a broker should possess are self-evaluation, neutrality and knowledge of project management. The competence to build a trustful relationship among the cooperation partners is essential, especially in the case of cooperation among companies in the same industry. Communication skills, solution-oriented work style and teamwork could also influence the success or failure of the broker's activities within a transfer, innovation or similar project. Due to the numerous stakeholders in an innovation project, and especially in a government funded project, brokers need to maintain an overview of all activities and processes during the project. As stated in the section on the methods and tools for a broker, networking activities are very significant for broker services. Therefore a significant competence is the ability to build and maintain local networks. The broker profile, which includes the knowledge, competence and skills necessary to a broker, can be applied very well to the local context of Saxony.

5.4 Ticino Regional System of Innovation: implications for the training of the Competence Broker

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Ticino is the southernmost Swiss canton and is on the border with Northern Italy. According to the data published by the Ticino Regional Statistics Centre (USTAT), in 2010 the resident population counted about 334.000 inhabitants, and more than 21 500 companies were active in the Ticino region, the majority of these being small (or even micro) and medium sized enterprises. In Canton Ticino there are more than 181.000 jobs, mostly in the tertiary sector. Despite the limited geographical dimension, the income produced in the cantonal territory is about 13 billion Swiss Francs, i.e. about 3.3% of the whole Swiss Gross Domestic Product.

In the context of the Rebasing project, the Conference for adult lifelong learning (CFC) of Southern Switzerland - silent partner in the project - started collaboration with the *inno3 Competence Centre* of the University of Applied Sciences and Arts of Southern Switzerland (SUPSI). In particular, *inno3* supplied scientific support during

the analysis and validation of the broker profile developed by the European partnership during the project.

At the beginning, *inno3* started its analysis by reconstructing the Ticino Regional System of Innovation. This made it possible to identify the main actors who are promoting innovation, entrepreneurship, competences and technology transfer. Subsequently companies and territorial needs were analysed and compared with the competences defined by the broker profile discussed during the Rebasing project. The comparison and analysis reported in the following paragraphs, have been drawn up starting from the results of an online survey submitted to a sample of companies based in the Ticino region and from the data collected during interviews and audits carried out in the field.

Considering the structure, economic, demographic and territorial peculiarities of Canton Ticino it is quite difficult to clearly identify the existence of an Open Innovation network, as defined by the literature.

Similarly to what is happening nationally and internationally, for at least the past 15 years Ticino has invested considerable human and financial resources in the support and promotion of entrepreneurship, particularly in terms of innovation, thereby recognizing the fundamental role of science, technology, and innovation in economic growth and social well-being (Alberton and Huber, 2012).

In the first years of the new millennium the number of initiatives and projects supporting these companies increased considerably. Such activities gradually led to the establishment of the Ticino Regional System of Innovation (illustrated in the following Figure 5.7).

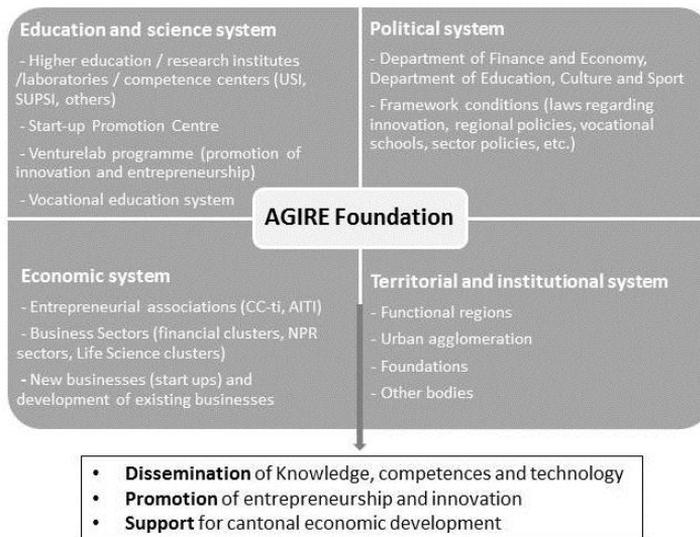


Figure 5.7 Ticino Regional System of Innovation

In the centre of the diagram is the *AGIRE Foundation*, the cantonal platform for the transfer of knowledge and technologies and for the promotion of entrepreneurship, which supports both cantonal and regional socio-economic development as well as projects implemented according to regional policy. The AGIRE Foundation works with companies in order to support the acquisition and transfer of knowledge and technologies and to assist them during the initial stages of innovation processes. For consulting services, the AGIRE Foundation can rely on internal resources and external business and technology advisors, who help companies to evaluate projects and guide them to create new collaborations with research and technology partners already present in the territory.

There are many private and public initiatives promoting entrepreneurship, such as the *Start-up Promotion Centre* and the *Venturelab* programme; the latter offers students and academic researchers various training and coaching possibilities to develop interesting ideas into entrepreneurial projects.

The University of Lugano (USI) and the University of Applied Sciences and Arts of Southern Switzerland (SUPSI) both play a key role in the cantonal education and science systems, in the fields of research (basic and applied) and education. Among the different training opportunities offered, the most significant programmes include the Master of Science in Business Administration with Major in Innovation Management (SUPSI), which provides students with in-depth knowledge and expertise in the fields of strategic enterprise management, innovation, and entrepreneurship (also understood in the sense of intrapreneurship). Even if there are some different nuances, the exit profile of students is almost aligned with the competence profile outlined during the Rebasing project. The same considerations apply to the competences applied by the Officers of the AGIRE Foundation and the Start-up Promotion Centre.

Over the last few years, the cantonal economic system has undergone a series of changes. In the traditional sectors of specialization of the cantonal economy (clothing, metallurgy, trade, construction, financial, and tourism-related business), significant developments have occurred in other sectors, which are more innovative, offer greater added value, and are more export-oriented. Examples include the machinery industry, electronics, ICT, optical and measurement instruments and devices, and the pharmaceutical industry, as well as scientific and technical firms and the healthcare sector. In Ticino and elsewhere, there are increasingly tangible signs of the development of meta sectors, where different areas intersect; this is the case for life sciences, the clean tech sector, computational science, ICT, and audiovisual business, as well as sustainable mobility. This is an unequivocal indication of a particular entrepreneurial vitality in those businesses and sectors that manage to best meet the challenges posed by the major trends currently recorded at demographic, technological, social, and environmental levels.

In the development of these meta sectors, professional figures such as the Broker could play an important role, particularly regarding the involvement of small and medium enterprises, their interconnections in specific clusters and the relationships between the educational, political, territorial and institutional systems.

The political system also needs to update tools and measures to better understand and react to today's changes. An example is the recent assessment of the Cantonal Law on economic innovation, which led to the proposal of a framework law designed to support and promote economic development (Alberton et al., 2011).

In conclusion, it is important to remember the territorial and institutional system itself, which also serves as physical, organizational and institutional support for educational, scientific, economic, and political systems.

With the advent of a new generation of regional and municipal aggregation policies (in which the transfer of knowledge and technologies is very important), territorial planning is making positive changes to the framework in which efforts toward entrepreneurship and innovation are organized and implemented.

In this field as well, a Broker training course could surely be relevant to consistently complete the above mentioned existing vocational profiles.

Despite the fact that development of Ticino's Regional System of Innovation is still under way, the first acquired results are positive. At all levels – government authorities, academic world and entrepreneurial contexts – the support and development of entrepreneurial initiatives promoting innovation, competence transfer and the application of new technologies have been detected. It is then essential to have professional profiles able to bring together the actors of Ticino's Regional System of Innovation, so that they can interact on the basis of the Triple Helix (Etzkowitz and Leydesdorff, 2000). It is generally known that the interaction among companies, especially small or medium sized, and research institutions, represents a crucial aspect of the competitiveness and development of a region. A study conducted on the cooperation existing on Canton Ticino's territory (Angotti et al., 2011), shows that local enterprises have some difficulty in relation to collaboration dynamics. This is mainly due to factors such as diffidence, a tendency to overprotect their own company's culture or lack of openness. Furthermore, cooperation with the academic and research world are discontinuous and sporadic. In this kind of context, the Broker can become a significant professional figure, especially for small and medium-size firms, which seem to suffer from a sort of inferiority complex to academic and research institutions. They seem to think themselves not adequately prepared, lacking competences and internal resources and not able to efficiently interact with the academic and research world.

As mentioned above, in order to better understand the significance, role and competences of a Broker in the entrepreneurial context of Canton Ticino, an online survey based on a sample of 247 companies was conducted. The number of questionnaires returned amounted to 90, with an answer ratio of 36%. The Broker turned out to be a useful professional figure in the opinion of Ticino's companies. Nevertheless, this usefulness has not yet transformed itself into a real need on the part of the enterprises. In fact 19 firms declared that they rely on a Broker, externally or internally, slightly more than 20% of those who sent the questionnaires back. Considering that most local companies are active only as sub-suppliers and that very often decisional power as well as research and development departments are based elsewhere (in other Swiss Cantons or in nearby Italy), these data are nonetheless significant as a marker of innovative entrepreneurial behaviours. Such firms, which

deal mainly in metallurgy, mechatronics and pharmaceutical chemistry, are of medium size and distinguish themselves for their high technological potential. Furthermore these enterprises are structured for the management of innovative projects. In particular they have helped outline the actual and ideal profiles of a Broker. Such procedure has allowed us to identify the principal activities carried out by a Broker as well as detect, through differentials, the needs and necessities of the companies themselves. The principal activities carried out are very often related to an analysis of technological needs and the selection/purchase process for a new technology. Technical-technological aspects prevail in a Broker's role. Nevertheless, the differential between actual and ideal profiles underlines a discrepancy in relation to strategic, organizational and managerial activities.

Companies show the need for evaluation of their organizational structure, an analysis of new trends, the creation of new ideas, etc. At the moment, such needs are completely or partially outside the Broker's mandate. This information is corroborated by an interview with a Broker (CTI-coach) from the Swiss Confederation's Innovation Promotion Agency. In fact, supply and demand on the part of the firms mainly derive from the need to assess and understand their own business. Furthermore, as shown by a recent exploratory study on the foresight phenomenon in Canton Ticino (Brenna et al., 2011), even when tendencies are monitored, enterprises have low skills in the interpretation and exploitation of opportunities. Consequently, in order to offset this deficiency, it is important for a Broker to develop the skills and competences needed to identify and interpret new tendencies, manage change, and quickly implement new and adequate strategies. In this sense, it is also important for the Broker to have developed a certain experience, not only for the company and the context in which s/he operates, but also in order to establish the strategic relationships and networks necessary to activate resources and skills in case of need, following the logic of the Triple Helix.

In our opinion not just one Broker should fulfil all the competences identified by the Rebasing project, but rather the network established by the Broker. This matter clearly emerges from the results of our survey. In fact most of the enterprises involved prefer the competences to be distributed on more than one individual rather than being concentrated on a single professional figure. The Broker should first of all be a negotiator, a communicator, a mediator and a person able to build a network and a cooperative team. Without these prevalently soft skills, it is difficult for a Broker to establish trusted relationships with his/her partners.

Reliance that the companies themselves seem to place on the Broker. Besides the enterprises already relying on this kind of professional, there are other firms which would like to engage them in the future. This hypothetical need for Brokers expressed by the companies could in the short to mid-term become a real and concrete necessity. For companies, a Broker must or should be trained inside the enterprise itself, but always in cooperation with training and educational institutions.

A possible solution for this particular need could be the development of lifelong training paths and modules, along which the experience developed in the company itself - as manager, entrepreneur, head of research and development etc. - could be placed. Such training courses should be dedicated not only to deepening specific

knowledge (sectorial know-how), but to particularly enhancing the development of the special competences related to strategic management of the firm, innovation and entrepreneurship. In these terms, considering the actual lack of training courses dedicated to the acquisition of such kind of competences, the Master in Business Administration with Major in Innovation Management proposed by SUPSI seems to be a valid and interesting offer.

As previously mentioned, the final competence profile of students attending the master courses while working, is very close to the profile defined during the Rebased project. In fact, at the end of the master's programme students are able to design, project, implement and manage innovation processes in every sector and apply them to specific strategic plans answering to real market opportunities. These graduate students could consequently be considered Junior Brokers. Following the guidelines developed by the Rebased project, convenient lifelong training paths could surely be pictured for the training and development of Senior Broker figures. These Competence Brokers will certainly be appreciated by all actors and stakeholders - companies, AGIRE Foundation, Start-up Promotion Centre etc. - involved in Ticino's Regional System of Innovation.

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6

The Research-based Competence Broker professional profile according to ECVET and EQF

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The professional profile of the Research-based Competence Broker is structured according to the methodological framework of the European Credit system for Vocational Education and Training (ECVET) and to the European Qualification Framework (EQF). The Tables summarise the key activities and the competences of the profile.

6.1 Introduction

Within the context of the Rebasing project, the ECVET and EQF definition of the Research-based Competence Broker profile was expected to be the final outcome of the partners' reflection on VRI Hordaland and Bergen University College's innovative approach and on its transferability. Indeed, the implementation of a common structure for the profile and the use of concept descriptions adopted from the ECVET and EQF policies, support the transparency and the legibility of the profile. Moreover, the comparison with professionals operating as brokers in partner countries allowed the profile to be improved and tested, taking into account local specificities.

The profile is structured following the ECVET and EQF descriptive frames, i.e. articulated in knowledge, skills, and competences (KSC). By knowledge, the two European policies mean the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. ECVET and EQF describe knowledge as theoretical and/or factual.

By skills, ECVET and EQF mean the ability to apply knowledge and use know-how to complete tasks and solve problems. Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

By competence, ECVET and EQF mean the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. Competence is described in terms of responsibility and autonomy.

6.2 Methodology

The design of the profile is based on several sources: firstly, the literature analysis of the broker profile conducted by the University of Padua – Department of Industrial Engineering and the University of Naples “Federico II” – Department of Business and Managerial Engineering; secondly, the characteristics of the role played by the Norwegian research-based competence broker; and finally, empirical evidence deriving from interviews to professionals, opinion leaders and companies carried out by the partners of the Rebasing project. Several key activities have been identified; the profile includes those that seem the most common ones. The Research-based Competence Broker profile namely includes a very broad range of knowledge, skills and competences: interviews and innovation audits brought out what practitioners may consider, i.e. that only part of these knowledge and skills assets are in their everyday work routine.

With reference to key activities, component activities are a description of tasks and, consequently, of the results that the broker should achieve.

ECVET Credit Points are assigned on the basis of the official information provided by the European Commission. ECVET is applied to learning outcomes achieved in a non-formal and informal learning context, as the broker’s job profile does not correspond to a formal qualification process (and thus a specific period of training) in partner countries. Therefore, the one-year pathway, corresponding to 60 CPs, is assumed as reference basis. In detail, a person might possess and express different levels of knowledge, skills and competences. Knowledge workers and highly specialised practitioners score a higher level of knowledge in comparison to the level of autonomy and responsibility. Therefore, it is pragmatically advisable to use the “prevalence” criterion of the knowledge and skills applied in job or informal training practices and in the professional and human development.

The lexicon used to describe the KSC of the profile is based on the syntax provided by the Veneto Region - Department of Labour, to develop ESF regional projects.

Knowledge lexicon: A phrase, i.e., methods, techniques, processes, procedures, etc. + a noun specifying the reference (e.g., “sales”, “quality control”).

Skills lexicon: Verb expressing a concrete action (i.e. to use, to apply, etc.) + a noun expressing the object of the action and/or its features (i.e. analysis techniques).

Competence lexicon: Infinitive verb + object defining the outcome + description of the basic conditions where the competence is expressed (i.e. -ing verb conjugation).

6.3 The profile

Table 6.1 Profile: The Research-based Competence Broker

Key activity	Component activity / Results
Prerequisite activity 0: Identify the company's business strategy	Identification of the corporate strategy adopted
Firm's innovation needs identification	Implementation of a systematic and regular audit of technological needs of the enterprise, so as to identify initial and on-going needs, and to analyse emerging trends Implementation of an organisational audit
Innovation goals identification and selection	Assessment of new technologies and innovation priority setting
Planning	Planning of a research and development process - project
Acquisition	Acquisition of investments for a research and development process - project
Exploitation and protection	Innovation exploitation and patent protection
Transversal and prerequisite activity 1: Networking	Building, maintaining and expanding networks among R&D providers and users

Table 6.2 The profile according to ECVET and EQF

ECVET points	Component activity / Results	Knowledge	Skills	Competences	EQF level
10	Component activity 0 Identify the company's business strategy	K.A Enterprise and its environment: - Resources - Product - Market	S.0.1 To adopt a coherent and trustworthy communication style	C.0.1 To set a mutual trust relationship C.0.2 To acquire the firm's commitment C.0.3 To identify the firm's market and its competitors	6

12	<p>Component activity 1</p> <p>Implementation of a systematic and regular audit of technological needs of the enterprise, in order to identify initial and on-going needs; to analyse emerging trends</p> <p>Implementation of an organisational audit</p>	<p>K.A Enterprise and its organisation:</p> <ul style="list-style-type: none"> - Production structure - Staff and human resources management - Methods of investment on research and development evaluation (technological audit) - Methods of project portfolio analysis (organisational audit) - Organisational models and methods for organisational analysis - Methods for market analysis - Logistics - ICT - Materials - Technologies - Other sector fields of interest 	<p>S.1.1 To identify initial and on-going needs, as well as emerging trends</p> <p>S.1.2 To understand the firm's human resource management policy</p> <p>S.1.3 To analyse the different forms of work organisation, identifying pros and cons</p> <p>S.1.4 To investigate the logistic structure of the company, identifying pros and cons</p> <p>S.1.5 To identify market signals</p> <p>S.1.6 To know and be updated about opportunities and features of the local/national territory with respect to sectors, markets and technologies</p> <p>S.1.7 To analyse ways to fund research and development</p>	<p>C.1.1 To identify the firm's needs in terms of skills</p> <p>C.1.2 To identify strengths and weaknesses of the organisational configuration</p> <p>C.1.3 To assess competing alternatives and to gain insight into those being more valuable</p> <p>C.1.4 To formulate hypotheses on the evolution of markets</p> <p>C.1.5 To formulate proposals for the improvement of R&D funding</p> <p>C.1.6 To help firms identify possible commercial opportunities provided by innovation</p>	6
8	<p>Component activity 2</p> <p>Assessment of new technologies and innovation priority setting</p>	<p>K.B Methodologies to analyse technological needs:</p> <ul style="list-style-type: none"> - Maturity of technologies - Transferability of technologies - Basic knowledge of the technologies typical of the existing sectors - Methods of technology intelligence, also through web-based tools 	<p>S.2.1 To analyse the technological configuration of the enterprise</p> <p>S.2.2 To acknowledge the firm's technology requirements</p> <p>S.2.3 To scan existing and emerging technologies</p>	<p>C.2.1 To develop an audit of technological needs on a systematic and regular basis</p> <p>C.2.2 To identify technological opportunities to improve the firm's development prospects</p> <p>C.2.3 To assess the transferability potential of existing and emerging technologies</p>	7

10	<p>Component activity 3</p> <p>Planning of a research and development process - project</p>	<p>K.C Methodologies to analyse R&D markets:</p> <ul style="list-style-type: none"> - Project management methods - Risk management methods 	<p>S.3.1 To identify a portfolio of innovation projects to foster competitiveness</p> <p>S.3.2 To assess and select appropriate partners/institutions</p> <p>S.3.3 To assess risks and develop strategies to manage them</p>	<p>C.3.1 To monitor research activities and cooperation opportunities, keeping contacts with professional and research networks</p> <p>C.3.2 To make proposals to firms about projects fostering competitiveness</p> <p>C.3.3 To define strengths and weaknesses of research and development projects</p> <p>C.3.4 To assist firms in formalising partnerships</p>	6
5	<p>Component activity 4</p> <p>Acquisition of investments for a research and development process - project</p>	<p>K. D Methodologies to identify funding sources and draw up a financial proposal:</p> <ul style="list-style-type: none"> - Investment acquisition techniques - Business planning methods 	<p>S.4.1 To identify appropriate financial suppliers/providers</p> <p>S.4.2 To estimate time and resource planning and scheduling activities</p>	<p>C.4.1 To assist firms in formalising partnerships</p> <p>C.4.2 To assist firms in formalising the project</p>	6
5	<p>Component activity 5</p> <p>Innovation exploitation and patent protection</p>	<p>K.E Methodologies to patent protected innovations.</p> <p>Legislation to protect / exploit innovations and intellectual properties.</p>	<p>S.5.1 To analyse legal constraints to the exploitation of existing and emerging technologies</p> <p>S.5.2 To apply local (national) regulations for patent protection</p>	<p>C.5.1 To assist firms in all problems related to the protection of innovation and intellectual property</p> <p>C.5.2 To formulate suggestions to the company on reinforcing its competitiveness by trading on patents</p>	6

10	<p>Component activity 6</p> <p>Building, maintaining and expanding networks among R&D providers and users</p>	<p>K.F Context analysis</p> <p>Features of the most represented sectors at local level</p> <p>Positioning and reputation of actors involved</p> <p>Understanding of policy levels</p> <p>Market knowledge</p> <p>Internal/external communication tools</p>	<p>S.6.1 To design a network strategy to improve the level of cooperation among innovation actors and initiate network activities</p> <p>S.6.2 To integrate relations to support network building and exchange activities</p> <p>S.6.3 To manage roles and to synchronize actions of the network members</p> <p>S.6.4 To use leadership and team building capabilities</p> <p>S.6.5 To reduce transaction and exchange costs</p> <p>S.6.6 To provide solution-oriented conflict management</p> <p>S.5.7 To assimilate and disseminate up-to-date information on partners and resources</p> <p>S.6.8 To avoid redundant processes and improve detection of synergies</p> <p>S.6.9 To apply relevant interpersonal aspects such as extraversion, empathy, emotional stability, self-reflection, sense of justice and cooperativeness</p>	<p>C.6.1 To initiate network activities among innovation actors</p> <p>C.6.2 To manage and maintain network exchange activities</p> <p>C.6.3 To coordinate and improve network activities</p>	6
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Appendix A

In the following we summarize the broker's intervention process and the main activities carried out by each broker.

The Technology Transfer Office is the Industrial Liaison Office of the University of Padua (Figure 2.2, Chapter 2). It was created in 2001, to give value to the know-how developed by the university and to increase collaboration between several research groups actively operating within the University of Padua and local enterprises, especially those of medium size. The brokers' team consists of about 5 employees whose competences are mainly of an economic nature.

The TTO activity is pulled by SMEs' demand. Several local firms, approximately 100 a year, turn to the TTO and ask to be put in contact with research groups having the necessary competences to solve specific innovation problems mostly revolving around technological issues.

The TTO activities are mainly focused on bringing together research groups belonging to university with SMEs. In order to act systematically, the brokers' team gathers information on the activities that the research groups of the University of Padua carry out, then stores the information into structured databases and participates in specific events for the purpose of informing businesses on the intermediation service that is being offered (back office activities).

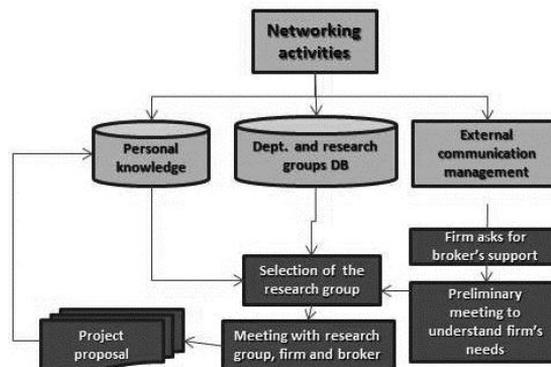


Figure 1a Intervention process - TTO

When a company asks for mediation from the TTO, the brokers' team collects detailed information on the company's needs, selects the individuals or research groups who work inside the university and then organises a meeting involving the company, the selected research group and one or two brokers of the TTO (Figure 1a).

The purpose of the brokers' intervention is to best manage the first meeting between the researchers and the SMEs, and - if necessary - to support the relationship between parties until the definition of a project proposal.

MaTech is an activity of the Galileo Science and Technology Park (Figure 2.2, Chapter 2), which provides consultancy for the research and application of new materials and related technology to product innovation. MaTech operates by researching and selecting the best technologies and materials for solving design and innovation issues. It employs a technical staff of 4 people having the necessary knowledge to select the materials and technologies which best suit the technical, functional and economic needs of its customers.

Thanks to the knowledge about materials and technologies already in use in some sectors, MaTech can become a source of innovation for other kinds of products and is able to help the emergence of effective, cost and time-contained research activities. MaTech's expertise is well-known to firms operating at the local level that turn to MaTech for specific problems, therefore its activity is pulled by SMEs' demand.

Usually SMEs ask MaTech a specific question, so the brokers' team does not need to devote a lot of time to the analysis of a company's needs, but tries to find the technical solution and the supplier(s) that could best meet the needs of the company. MaTech's activity ends with a written proposal that generally describes the solution to the specific problem and also gives a detailed estimate of the costs of the technology and/or material proposed (Figure 2a).

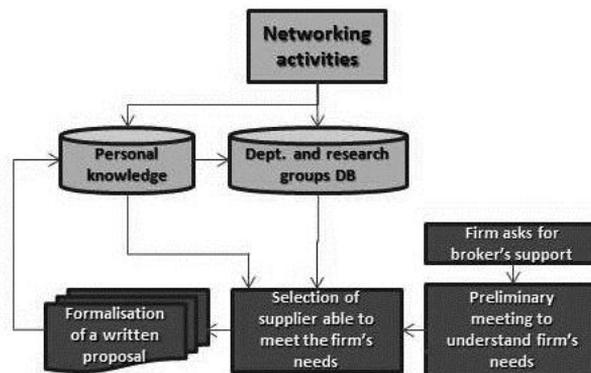


Figure 2a Intervention process - MaTech

Area Science Park is a technology transfer and multi-sector Science and Technology Park which provides support services to the development of activities based on knowledge and technology (Figure 2.2, Chapter 2). The brokerage team consists of about four people with technical competences, who operate to support the link between research centres and SMEs. In addition to the management team there are currently 20 technology brokers across 6 competence centres and various projects in AREA's Technology Transfer department (STT), who actively work with SMEs to define their innovation needs and with the research community to enhance the results of their research.

The brokerage team activity is mainly pushed by firms' demand: a broker visits many firms for the purpose of verifying the innovation needs in the strategic, organisational and technological fields, as well as the availability of internal economic and human resources. Even if there is a large number of visits, which shows the need for innovation projects to be implemented, an actual project does not always unfold, as most SMEs have limited resources to invest in an innovative project.

In 10% of the preliminary visits, a project is defined and directly supervised by the internal centres of the science park area or by one of the centres that is connected with them. The brokers involved, who were responsible for the setup of the project, usually become the project managers and take care of the whole implementation. Their main activities are summarized in Figure 3a.

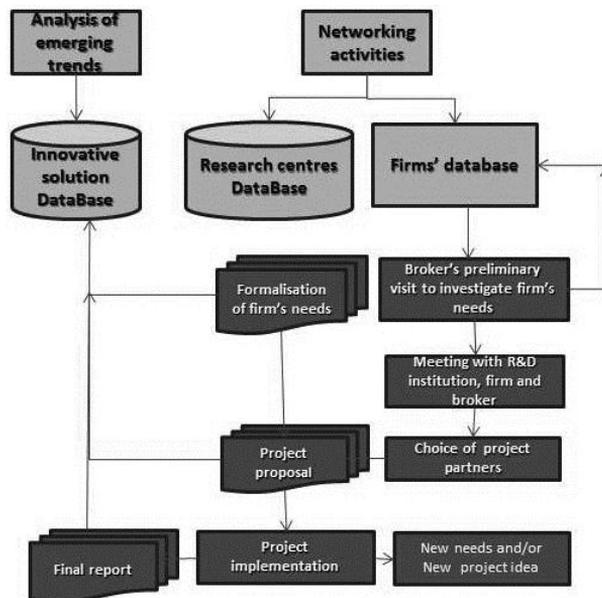


Figure 3a Intervention process - Area Science Park

Treviso Tecnologia is the Special Agency for Innovation established in 1989 by the Chamber of Commerce, Industry, Craft and Agriculture (CCIAA) of Treviso, with the intent of fostering an innovation-oriented corporate culture (Figure 2.2, Chapter 2). With this in mind, a brokerage team of 5 people operate as innovation supporters offering heterogeneous competences (humanistic, economic and technological, meeting the various needs of the different activities to be implemented). Collaborations with the university and international research institutes – such as the network of Fraunhofer Institutes – promote technology transfer initiatives and enable the development of projects whose aim is to experiment and to help local enterprises grow in especially competitive contexts at the international level. Foreign subsidiaries are more innovative compared to domestic firms. Their innovativeness is heavily based on knowledge transfers from associated companies in addition to local knowledge. Therefore, a foreign subsidiary can be regarded as an important partner (Figure 2.2, Chapter 2).

It carries out both a pull and a push kind of activity. In some cases, a company contacts a broker for support in the development of innovative projects; in other cases, it is the broker's team that visits a company and provides it with support in the technological feasibility study of a certain idea (technology intelligence) and carries out technology transfer initiatives. Brokers' activities are made easier by the existing strategic partnerships, cooperation agreements and international networks of Treviso Technology with research institutes and universities.

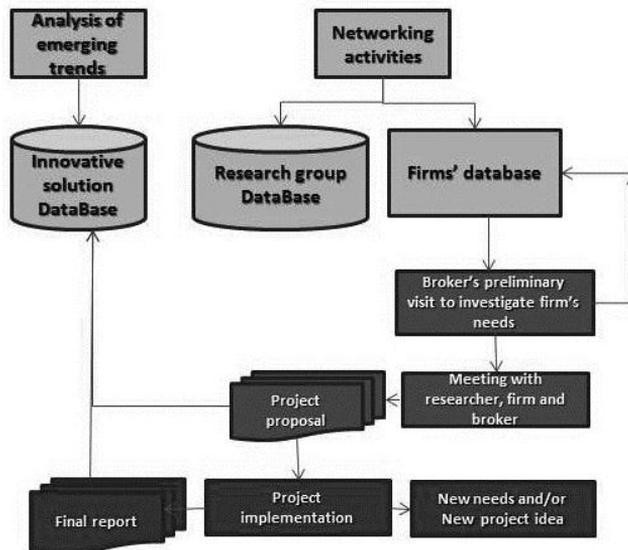


Figure 4 Intervention process - Treviso Tecnologia

If the project idea proposed by the broker receives a positive evaluation, the enterprise may independently develop the project or the enterprise may ask support to find funds and resources, or operational assistance to carry out the project (Figure 4a). In order to favour innovation, the feasibility analysis is a service that Treviso Tecnologia offers free of charge, whereas the activities of any project that may ensue are available at a cost.

Fondazione Bruno Kessler employs about 350 researchers, conducting studies in many research areas. In 2009, to favour the diffusion and adoption of its Information Technology, Materials and Microsystems research centres, *Fondazione Bruno Kessler* in agreement with Confindustria Trento, created a small brokerage team to create a link between its research teams and local companies. The activity of the broker team pulls SMEs' demand (Figure 2.2, Chapter 2).

Every month the broker takes part in the meetings organised by the research group leaders to gather information on the activities that were carried out, on the results of research activities and on the level of saturation of the 26 research groups that work inside the foundation. The same broker systematically visits several firms to assess their needs for innovation, especially technological ones, the availability of internal economic and human resources and whether the top management is willing to start innovation projects.

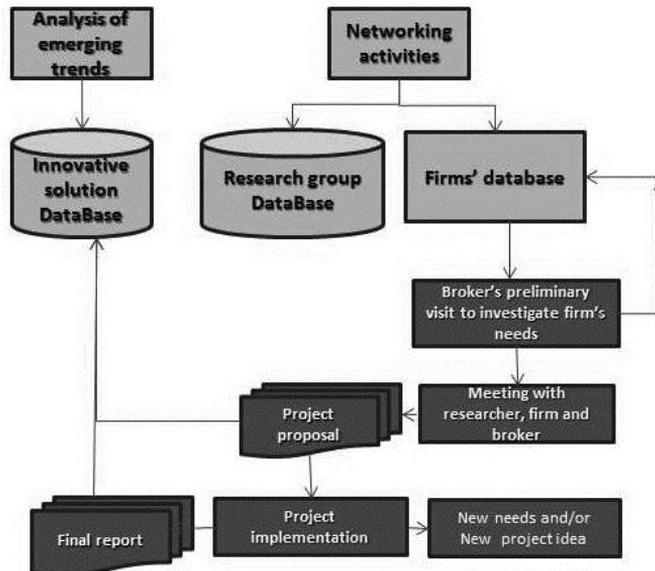


Figure 5 Intervention process - Fondazione Bruno Kessler

Considering the firms' needs and the saturation level of the research groups, after 2-3 weeks the broker submits a feasibility study of a project that the company could be interested in. If the company decides to implement the proposed project, the broker will supervise the partial and final results of the project during its implementation (Figure 5a).

The Employers' Association of Belluno – Confindustria Belluno Dolomiti. It is a local association whose mission is to provide services to enterprises working in a restricted territory (i.e. the province of Belluno). In order to promote the development of innovation, especially in small-sized enterprises, a brokerage service was created a few years ago to encourage collaboration between research institutes and small enterprises (Figure 2.2, Chapter 2). The broker's activity is both pull and push. The association periodically organises events for the purpose of informing about the broker team's activities.

A broker systematically offers his/her services to the companies or responds to their requests, therefore he/she can assess their needs and recommend any research institute that could collaborate with them to solve specific problems. The broker then calls follow-up meetings to verify whether the research institute's intervention has been successful (Figure 6a).

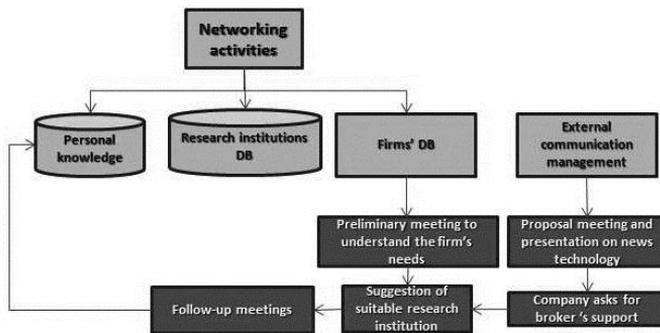


Figure 6a Intervention process - Employers' Association of Belluno

Appendix B

The broker's competence profile from case studies

Table 1b The broker's competence profile - Case study 1

TYPE OF KEY ACITIVITIES	COMPETENCE	SKILLS	KNOWLEDGE
1. Firm's innovation needs identification	C.1 Capability of accurately identifying the needs of the robot's customers (what expectations? What industrial applications? Which industrial application in different sectors?)	C.1.S.1 Replication capability of knowledge acquired in past experiences C.1.S.2 Ability to integrate and apply knowledge in the field of mechanics and electronics	C.1.K.1 Advanced mechanical knowledge C.1.K.2 Advanced hardware and software knowledge C.1.K.3 Manufacturing systems and manufacturing engineering knowledge
2. Innovation goals identification and selection	C.2 Capability to link a specific firm's problems to the most adequate research centre	C.2.S.1 Acknowledgement of technological partners on the basis of their ability to successfully cooperate with the firm	C.2.K.1 Knowledge about research centre capabilities and abilities C.2.K.2 Knowledge about processed research and activities
3. Acquisition and planning	C.3 Capabilities to identify those departments and laboratories able to contribute to the evaluation of technical requirements	C.3.S.1 Ability to select partners	C.3.K.1 Knowledge about industrial research labs

4. Networking	C.4.1 Capabilities to involve professors and researchers	C.4.S.1 Ability to “speak and understand” a scientific language	C.4.K.1 Knowledge about the main scientific journals C.4.1.K.2 Knowledge about technological progress made C.4.1.K.3 Knowledge about research and development among the partners involved
	C.4.2 Capabilities to report the innovation need to researchers, clearly explaining the necessary requirements	C.4.2.S.1 Ability to identify the role of technological partners in robot industrialization	C.4.2.K.1 Knowledge about the industrial application of the new robot

Table 2b The broker’s competence profile - Case study 2

TYPE OF KEY ACITIVITIES	ACTIVITY	COMPETENCES	SKILLS	KNOWLEDGE
1. Innovation goals identification and selection	Definition of the furnace characteristics, in particular: solving the problem of having the necessary level of carbon but not too high to avoid "poisoning" the stainless steel; cooperation with the supplier has solved the problem by	C.1 Ability to use previous experiences both in the firm and in the university	C.1. S.1 Mapping technology partners (suppliers) that can potentially help in the innovation design, through their own research and instrumentation development opportunities	C.1.K.1 In-depth knowledge of technology partners (suppliers) C.1.K.2 Thorough understanding of the stainless steel sintering process and of the average sintered alloy steel

	providing adjustable bulkheads to be used			
2. Acquisition and planning	Identification and selection of potential partners for technology transfer (both on the supplier side, during the project definition and implementation of the oven, and with universities, during the development of the system)	C.2 Ability to identify appropriate partners in the world of technology providers, research centres and universities that can contribute to the development of the project	C.2.S.1 Know how to select technology partners	C.2.K.1 Thorough knowledge of the world of European equipment suppliers C.2.K.2 Knowledge of departments and search for possible involvement (and trust)
3. Networking	Partnership development with suppliers	C.3 Ability to illustrate innovation needs to the research partners through the clarification of requirements to be met	C.3.S.1 Know how to identify the contribution that technology partners can provide to make possible new applications of industrial robots	C.3.K.1 Knowledge of the product life-cycle analysis technique
4. Exploitation	Plant improvement	C.4 Ability to cooperate with university partners in solving problems	C.4.S.1 Know how to identify technological partners suitable for problem solving	C.4.K.1 Knowledge of departments and search for possible involvement (and trust)

Table 3b The broker's competence profile - Case study 3

TYPE OF KEY ACITIVITIES	ACTIVITY	COMPETENCE	SKILLS	KNOWLEDGE
1. Firm's innovation needs identification	New product development (FiorDiGrano)	C.1 Identification of market needs (high quality product to be achieved in the same region where the entire supply chain belongs to)	C.1.S.1 Knowledge application capabilities (e.g. know-how and knowledge of the production process)	C.1.K.1 Agro-food sector knowledge C.1.K.2 Agro-food supply chain knowledge
2. Innovation goals identification and selection	Definition of product characteristics Supply chain integration	C.2 Selection of actors in the supply chain to be involved in the project	C.2.S.1 Ability to identify and select supply chain actors	C.2.K.1 Deep knowledge of supply chain actors C.2.K.2 Deep knowledge of production processes
3. Acquisition and planning	Identification and selection of partners for technology transfer activities	C.3 Ability to identify the best partners from universities and research centres	C.3.S.1 Ability to select university and research centre partners	C.3.K.1 Knowledge about the world of universities and research centres
4. Networking	Partners' cooperation development	C.4.1 Ability to involve professors from universities or research centres	C.4.S.1 Ability to "speak and understand" a scientific language	C.4.1.K.1 Knowledge about the main meetings and exhibitions that universities and research centres attend C.4.1.K.2 Knowledge about technological progress in the specific sector

				that scientific partners belong to C.4.1.K.3 Knowledge about scientific partners' research projects
5. Exploitation	Supply chain integration	C.4.2 Ability to exploit new product requirements from university partners (e.g.: How can the supply chain be integrated? Which processes are at stake? What is the process for achieving the quality certification of the entire supply chain?)	C.4.2.S.1 Identify the role played by each university partner in the project	C.4.2.K.1 Knowledge about the future performance of the integrated supply chain

Table 4b The broker's competence profile - Case study 4

TYPE OF KEY ACITIVITIES	ACTIVITY	COMPETENCE	SKILLS	KNOWLEDGE
1. Firm's innovation needs identification	New process development (Olfactometer)	C.1 Identification of market needs (high quality product to be achieved following an innovative production process)	C.1.S.1 Knowledge application capabilities (e.g. know-how and knowledge of the production process) C.1.S.2 Ability to identify technological innovativeness	C.1.K.1 Knowledge about the sector C.1.K.2 Knowledge about technologies

2. Innovation goals identification and selection	Definition of process characteristics	C.2 Ability to identify new technologies for the production process	C.2.S.1 Knowledge about the main technological processes	C.2.K.1 Advanced knowledge about technological producers of gas chromatographs C.2.K.2 Basic knowledge about the vinegar production process
3. Acquisition and planning	Identification and selection of partners for technology transfer activities	C.3 Ability to identify the best partners from universities and research centres	C.3.S.1 Ability to select university and research centre partners	C.3.K.1 Knowledge about the world of universities and research centres
4. Networking	Partners' cooperation development	C.4.1 Ability to involve professors from universities or research centres	C.4.S.1 Ability to "speak and understand" a scientific language	C.4.1.K.1 Knowledge about the main meetings and exhibitions that universities and research centres attend C.4.1.K.2 Knowledge about technological progress in the specific sector that scientific partners belong to C.4.1.K.3 Knowledge about scientific partners' research projects

Table 5b The broker's competence profile - Case study 5 (SPIN-OFF)

KEY ACTIVITIES	COMPETENCES	SKILLS	KNOWLEDGE
1. Technology Scouting	C.1 Ability to identify and collect technological knowledge developed within university departments, and to select the one with the highest chance of industrial application	C.1.S.1 Scanning of existing and emerging technologies	C.1.K.1 Advanced knowledge of internal resources (departments and labs) C.1.K.2 Knowledge basis of research activity processes C.1.K.3 Technology assessment methods
2. Knowledge exploitation and codification	C.2.1 Ability to help researchers in finding the patentability of their ideas and discoveries, and of the industrial application of their research	C.2.1.S.1 Ability to analyse innovation needs in different industrial sectors	C.2.1.K.1 Knowledge of process/product innovation needs
	C.2.2 Ability to help the researcher in defining the innovation process and in estimating the time-to-market	C.2.2.S.1 Planning and control capabilities	C.2.2.K.1 Knowledge about project and time management
	C.2.3 Ability to help the researcher in the commercial evaluation of the patented application	C.2.3.S.1 Market auditing capability C.2.3.S.2 Ability to obtain information about target markets for the patent C.2.3.S.3 Ability to estimate the growth rate of the market C.2.3.S.4 Project failure risk assessment ability	C.3.K.1 Knowledge about market auditing techniques C.3.K.2 Knowledge about product life-cycle analysis techniques C.3.K.3 Knowledge about risk management techniques

3. Patent development assistance (Protection)	C.3 Ability to assist the researcher in the patent filing process	C.3.S.1 Patent filing management ability C.3.S.2 Communication strategies for dealing with institutions and professionals in the patent filing process	C.1.K.1 Advanced knowledge of internal resources (departments and labs) C.1.K.2 Knowledge basis of research activity processes C.1.K.3 Technology assessment methods C.1.K.4 Knowledge about the patent filing process
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Table 6b The broker's competence profile - Case study 6 (PATENT)

KEY ACTIVITIES	COMPETECES	SKILLS	KNOWLEDGE
1. Technology Scouting	C.1 Monitor and select technical knowledge and patents developed in the departments, to identify opportunities for enhancement through the development of spin-off activities	C.1.S.1 Scanning of opportunities for the enhancement of business and patents, and of existing technological knowledge	C.1.S.1.K.1 Thorough knowledge of departments and research centres, of their activities and research areas C.1.S.1.K.2 Knowledge of opportunities to develop new products / services in high-tech sectors
2. Knowledge exploitation and codification	C.2 Support young graduates and researchers in the exploitation of business ideas based on the results of their research	C.2.S.1 Market analysis capabilities C.2.S.2 Ability to develop new products /services/concepts	C.2.1.K.1 Knowledge of market analysis techniques

3. Innovation goals identification and selection	C.3 Support young graduates in developing the business idea and business plan	C.3.S.1 Ability to apply business planning tools and techniques C.3.S.2 Communication skills	C.3.S.1.K.1 Business planning knowledge
4. Project planning and control	C.4 Coordinate the development of business plans on time and expected costs	C.4.S.1 Ability to plan and control activities	C.2.2.K.1 Thorough knowledge of project and time management tools and techniques
5. Networking	C.5 Build a support network to the group of young graduates	C.5.S.1 Ability to select specialist advisers C.5.S.2 Ability to raise funds	C.5.S.1.K.1 Knowledge of the consulting industry C.5.S.2.K.1 Knowledge about venture capital activities

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The Innovation Competence Broker: Bridging firms and R&D institutions

Innovation has become a core action in Europe with which to face increased global competition and exploit new development opportunities. To be effective, innovation must represent an interactive, collaborative process involving private and public knowledge providers, firms and policy makers.

Within the Norwegian Programme for Regional R&D and Innovation (VRI), the figure of the Research-based Competence Broker has proved to be an effective tool to support Open Innovation in SMEs. Therefore, this publication contributes to the provision of a detailed overview of his/her activities and profile.

The book is composed of three parts: the first shows the literature and results of case studies carried out in Norway, Italy and Estonia to define the process of intervention and a model of Innovation Broker profile; the second highlights the outcomes of in-the-field observation of Broker profiles in Italy, Germany and Switzerland and presents a validated profile, described according to ECVET (European Credit System for Vocational Educational and Training) and EQF (European Qualifications Framework); the third collects the main activities of a Broker in six Organisations in Northern Italy and identifies the competences of six Brokers in Southern Italy.

This publication was designed and implemented in the context of the "Research-based Competence Brokering - REBASING" Project of the Leonardo da Vinci - Lifelong Learning Programme aimed at improving cooperation between the providers of knowledge and enterprises.



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