

Innovation support for new technology-based firms: the Swedish Teknopol approach

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Small and medium sized firms in general and new technology-based firms in particular, serve as promoters of future economical growth. Therefore, it is of crucial importance to understand and satisfy their needs for innovation support services in regard to both the type of service and quality of delivery (e.g. confidentiality, speed).¹ Drawing upon a database of 259 new technology-based firms (NTBF) and 106 researchers, we have identified four needs bundles: marketing, technology, financing and soft service support. We have evaluated the effectiveness of the Swedish Teknopol scheme to meet these needs based upon 35 in-depth interviews with NTBFs. The conclusions of the evaluation are presented both for policy makers and NTBF managers.

Aims and scope

The objective of this study is twofold: to map the needs of NTBFs for innovation support services and to identify the core success factors in meeting these needs. Previous studies have shown that NTBFs are important generators of economic growth (Jones-Evans and Klofsten, 1997; Bower, 1992). At the same time they encounter difficulties in fully exploiting their potential. An example of this can be clearly seen in the RITTS projects of the European Union.² Substantial positive externalities which we refer to as 'leverage effects' can be realised by helping firms overcome bottlenecks in their innovation processes, be they in marketing, finance, technology or management (Castells and Hall, 1994; Cook, 1996; Klofsten *et al.*, 1988; Samson and Gurdon, 1993; Westhead and Storey, 1994).

Despite recent shifts in emphasis, innovation policy still favours large companies and tends to be focused primarily on technology.³ The prioritisation of large

companies over small and medium-sized enterprises, especially entrepreneurs, is a by-product of heavily financing and fostering pre-competitive research efforts at universities and research institutes without simultaneously supporting applied research and development to the same degree. The public rationale behind this policy is the view that financial support for basic research does not interfere with the free market but supporting development work and commercialisation activities does interfere. However, valuable knowledge resulting from publicly financed research can be accessed more easily by large companies than by small and medium-sized companies.

This is caused by the core mission of research institutes and universities to develop leading-edge technologies and education programmes. In daily life, individuals at universities and publicly (co-) financed research institutes are judged by their research performance rather than by other parameters such as their contribution to regional development. Personal

advancement is gained by patents and publications and not by the number of jobs created. Consequently, research institutes and universities choose to focus on maintaining relationships with those partners that will most likely contribute to the mission of the Research and Technology Organisation (RTO) through the provision of advanced technological know-how and equipment and/or significant long-term financial support. Also, an industrial partner should leverage the status of the technology provider by serving as a prestigious reference customer. Typically, new technology-based firms do not fulfil these prerequisites as well as large companies and are consequently not regarded as prime target groups by RTOs. Thus, they are systematically disadvantaged by public technology policy, especially innovation policy.

The technology-push approach is dominant in both technology policy and in research on innovation success. Nearly all studies focus on analysis of the utilisation of external resources instead of the degree to which companies' needs are satisfied. The majority of research is aimed at developing recommendations on how the existing innovation support infrastructure⁴ can be better exploited. In contrast, we focus on how companies' needs can better be satisfied. There is also a substantial amount of theoretical and empirical literature on how to efficiently support business processes in general and innovation processes in particular, although the majority of these studies are configuration-oriented. The studies focus on static arrangements of hardware nature such as facilities, budgets, organisational structures, geographical location and institutional links (Autio and Klofsten, 1998). They do not fully explain why certain support activities are more successful than others.

It is very important to understand and take into account that small businesses are not a homogeneous population, and that the attitudes concerning support are very different between single firms and between groups of firms. It is necessary to adapt small business support to the respective stage of development of each business (Gibb, 1996; Jones-Evans and Klofsten, 1997; Kirby, 1990; Klofsten and Jones-Evans, 1996; Klofsten and Mikaelsson, 1996). Consequently, not all SMEs have benefited from the various types of external innovation support services that are available. However, the vast majority of empirical research analyses whether a greater degree of collaboration with external actors generally leads to a higher level of innovation success. Few studies focus on companies' needs for external support in innovation processes, their barriers in accessing external competence and the degree of need satisfaction.⁵ In our study the starting point for analysis is to address the needs and problems of an entrepreneur, especially an NTBF, in commercialising technical success.

Figure 1 illustrates the process of commercialising research results, either by starting a company or by

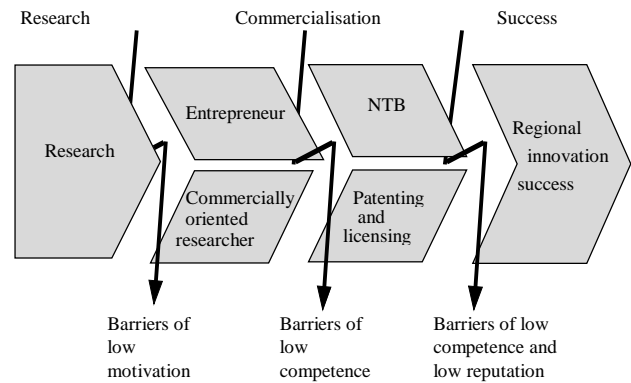


Figure 1. The process of commercialising research results.

licensing an invention (cf. inno, 1996; Heydebreck and Maier, 1997). The upper process represents the type of entrepreneurs who found their own businesses (e.g. a new technology-based firm (NTBF) outside the institutional research framework). The lower process describes the exploitation of results deriving from public research by established companies. The initiative may either be taken by commercially-oriented researchers who want to market their invention or by another established company looking for a solution to a technical problem. In this process, the researchers develop entrepreneurial activities but remain within the public research system. Both the upper and the lower processes may lead to commercial innovation success but they require different types of people and support services.

Promoting the growth of new technology-based firms: the Swedish Teknopol approach

In this paper we present and discuss a Swedish support scheme that aims to overcome the gaps in the process illustrated in Figure 1. The Swedish National Board administers the scheme for Technology and Development (NUTEK). The prime motive for running the scheme is the huge imbalance between high R&D expenditures (which are higher per capita in Sweden than in any other country in Western Europe, OECD, 1996) and the limited commercial effects of publicly sponsored research. Despite all plausible strategic motivation, it was due to the initiative of a single individual at NUTEK who, instead of providing equal amounts of money to all support actors, dared to support more strongly the best performing actors, and brought them together in the Teknopol family.

Within the Teknopol programme, NUTEK provides the regional hands-on support actors with financial resources and an arena for the exchange of experiences enabling them to react very flexibly to the needs of entrepreneurs and NTBFs. The Teknopol scheme is intended to provide individuals and NTBFs with

support throughout the whole process of commercialising inventions. It takes a holistic approach to overcome the existing barriers that prevent individuals from starting their own businesses (such as lack of motivation and self-confidence) and that prevent NTBFs from growing (e.g. inadequate financial resources and marketing, general management and network management skills).

The Teknopol scheme was not established on a specified date, but has grown organically. During the 1980s, an increasing number of universities intensified their efforts to foster the commercialisation of new technologies. Two Swedish universities were particularly successful in promoting the growth of the regional economy, namely Chalmers University of Technology (Gothenburg) and Linköping University. Similar initiatives developed in other places, either at the universities or with strong connections to the university. NUTEK has selected Chalmers and Linköping as well as the most successful followers (Lulëa, Lund, Stockholm, Umëa and Uppsala) and acquires services from them for which there is not any commercial market (e.g. motivation of researchers and students to start their own businesses, raising awareness for unrealised needs). It is characteristic of the Teknopol programme that money is given to well established high performing actors with efficient networks in order to allow them to offer additional services for entrepreneurs and new technology-based firms. Their reputation is further leveraged by the NUTEK support which is granted to only one, carefully selected, actor in the particular region. This approach is a positive move towards increased transparency and rejects very consciously the establishment of new actors. Thus, a significant leverage effect can be realised. Today, this process is established as the Teknopol support programme. The total budget of the scheme amounts to Skr12 million (1.3 million Euro) per year.

It is not realistic for a single organisation to satisfy all of the target company needs using only their own internal resources and so the Teknopols have not been forced to become all-round performers. Instead, NUTEK has designed the Teknopol scheme to allow the different Teknopols to develop and exploit their individual strategic strengths. NUTEK buys different services from each Teknopol. What all Teknopols have in common (at least to some degree) is that they serve as an entry-point into the system of innovation support. They assign priority to the provision of soft support services, and can provide access and some expertise for technology, finance and marketing service packages. The Teknopols employ the following means of providing external innovation support:

- Raising awareness for unrecognised needs. There are two main ways to encourage entrepreneurs and companies to recognise their needs. The first method is to approach companies pro-actively and

discuss their challenges face-to-face. The second way is by using a mentor. Both methods require a thorough understanding and knowledge of entrepreneurs' and NTBFs' needs. Strong communication skills are required to approach companies pro-actively; mentoring depends on a high reputation and acceptance by the target company.

- Problem-solving based on internal competence. Problem-solving may be done best by directly consulting the entrepreneurs or NTBFs and drawing upon internal expert know-how. To succeed with this approach takes a needs-oriented approach and a high degree of professionalism (e.g. confidentiality and on-time delivery).
- Arranging external competence. Teknopols may assist their clients in accessing external resources; they must draw upon their own well elaborated network, which will be characterised by personal trust-based relationships.
- Developing companies' competence in problem solving. Teknopols may run courses and seminars providing potential and actual entrepreneurs with knowledge on selected relevant topics.
- Developing an efficient innovation support system. If the regional innovation support infrastructure is inadequate, Teknopols may be forced to develop it further. This can be achieved by offering new services, by encouraging other agencies to modify their services or by actively promoting the foundation of new support agencies. In order to do this effectively, the Teknopols must be very well aware of which company needs are unsatisfied. It takes entrepreneurial skills and spirit to initiate new agencies and trust-based relationships and diplomacy to convince other agencies to modify their service portfolio.

Methodology

The study deals with two core research questions: (1) What are the needs of NTBFs? and (2) What does it take to satisfy them? We have used a two-stage approach in order to cover both questions adequately.

1. Mapping the companies' needs: a large and representative sample of target group companies is needed in order to quantify the needs of NTBFs for innovation support services. In order to build up an adequate database we conducted 259 telephone interviews with the managing directors of NTBFs (key informant approach) and 106 telephone interviews with researchers at universities in Sweden located in Gothenburg, Linköping, Lulëa, Lund, Stockholm, Uppsala and Umëa. These interviews were guided by a standardised questionnaire, which was pre-tested on a sample of 20 NTBFs. The pre-test did not result in major

changes to the questionnaire. 85% of the firms responded; a few did not have the time to discuss our questions. The individual Teknopol differ significantly in respect to their definition of target NTBFs. Teknikhögden in Stockholm works for only a very limited number of NTBFs – those located on-site at Teknikhögden Science Park. Chalmers Innovation in Gothenburg works exclusively for Chalmers spin-offs, whereas Teknopol AB in Lund has recently drastically broadened its target group from the limited range of companies located in the IDEON science park to all NTBFs (if not SMEs) in Southern Sweden. Thus it makes little sense to calculate a percentage indicating the coverage of the total sample. In this paper all statistical analyses draw exclusively on the company data.

2. Evaluating the effects of the Teknopol scheme. We are interested in understanding the causal mechanisms between providing innovation support services and company success.⁶ In order to collect the data, we have performed in-depth face-to-face interviews with 35 selected NTBFs. Typically we spoke to the managing director and at least one more person in the company. Due to the high heterogeneity of NTBFs' organisational structure, this second person could occupy very different positions (e.g. shareholder, head of development). The average discussion time per NTBF has been approximately five hours. We personally spoke to
 - 10 randomly selected NTBFs, which had not answered our standardised questionnaire (5 of them had not been asked and five had denied a telephone interview but agreed to a face-to-face interview).
 - 5 randomly selected NTBFs, which had responded to our telephone interviews.
 - 10 NTBFs which had reported decisive positive outcomes of employing a Teknopol.
 - 5 NTBFs identified as dissatisfied with Teknopol support.
 - 5 NTBFs which appeared interesting due to other specific aspects.

The face-to-face interviews were primarily used to analyse the demands of NTBFs on the design of the transfer of competence process and the effects of the Teknopol scheme, but also to test the validity of the large-scale quantitative analysis.

Types of Teknopol

With respect to the interaction of the Teknopol with their different target groups and the assistance they provide, three types of Teknopol can be distinguished which will be described below.

Pro-active developers

This type of Teknopol very actively approaches target group actors at a very early stage in the commercialising process and raises the awareness of those needs which have not been sufficiently taken into account by companies and entrepreneurs. Usually, the Teknopol itself does not directly solve the problems. Instead, the Teknopol either offers training programmes to develop the target groups' internal management competence, or actively links the companies and entrepreneurs with adequate third parties and acts as a filter and a credibility provider with respect to the problem solvers. If no efficient third parties exist, the Teknopol takes the first steps in setting up an efficient innovation support infrastructure.

In order to play this role, the Teknopol must understand the real needs and strengths of the companies very well, partly better than the companies themselves do, which means that the Teknopol must succeed in engaging in trust-based, long-term relationships with the target group actors. Also, they must have the freedom to deny close partnership to some actors. Pro-active developers profit from an image, which is not fully commercially based but comprises elements of public support as well. This image is provided by university-associated institutions.

Service providers for NTBFs

This type of Teknopol either owns a science park or has very strong links to it. It offers a wide range of services to the companies on site and a restricted range of services to clearly defined members off-site. Infrastructure and soft support services are offered out of its own resources; in addition, competence in financial aspects is usually very high. In case the companies need expert advice outside these areas, the Teknopol recommends selected partners out of its network.

This type of Teknopol actively develops a co-operative innovative climate on site and tries to stimulate a feeling of belonging together. Less than coffee break distance from company to company stimulates open and constructive discussion among on-site companies. Even Teknopol of other types can succeed in creating this atmosphere, but they have to put in much more effort. Usually, this Teknopol acts on demand. The philosophy lying behind this concept is to serve as a spin-out channel for partner universities by providing hands-on support for NTBFs during a limited period of time (e.g. five years) and then decrease the support gradually.

Problem solvers

This type of Teknopol acts primarily on specific demand of companies and very often possesses internal problem-solving competence. This does not mean that

this Teknopol hides itself waiting for customers. On the contrary, it very actively markets its own services. In case additional expert advice is needed to work out very specific aspects, the target group actors are referred to close partners of the Teknopol. This type of Teknopol does not strive for long partnerships but tries to work out a company's specific problem and then heads off for new customers. It has a professional image, is independent from any university, but nevertheless regards one or several universities as valuable external partners.

Companies' needs for external support services

We have measured the existing articulated needs of NTBFs (i.e. needs which are known to the entrepreneurs themselves). Our motivation for doing so is that we have good reason to believe that most entrepreneurs only state needs which they actually encounter. On the other hand, there certainly are a significant number of problems and options, of which the entrepreneurs are not aware. This implies that our analysis would systematically under-estimate the real needs of NTBFs. Consequently, the actual gap between NTBFs' needs (latent plus realised) and their satisfied needs is even bigger than our analysis shows. This means that Teknopol has a responsibility not only for satisfying NTBFs' needs, but also of raising their awareness of the relevance of latent needs. The companies express the highest needs with respect to external support in the field of marketing-related assistance. Still, it is our impression that particularly

new technology-based firms tend to under-estimate the significance of market investments.

However, the Teknopol scheme is different. As the core competence of researchers and research-based entrepreneurs is technology, the main problem for the target group of the Teknopol is not technology, but marketing. If the companies cannot handle a major part of the technology, they are in trouble anyway. This can be compared to a baker, who simply has to know how to bake before starting a bakery. If he does not, it is very questionable whether he should be supported, as hardly any leverage effect can be achieved. It has been recognised that one of the key problems new technology-based firms have to face is to discover which of their innovative ideas have the potential for economic success and how they can market their products and technologies. In these areas most of the questioned companies needed external support. The total length of the bars in Figure 2 illustrates the overall need for a specific service. The light colour bar shows the respective percentage of companies that started to have some needs, whereas high needs are marked by dark colour.

When analysing the structure of companies' needs, it is important to take into account that companies often experience problems, which usually are the result of different underlying causes. These causes are often very diverse and cannot be solved by considering a single offer of external support at a time. Drawing upon this assumption we have performed a factor analysis which resulted in four dimensions of needs for innovation support services. As the rotated factor matrix corresponds to previous findings and theoretical conclusions, we have performed four confirmatory factor

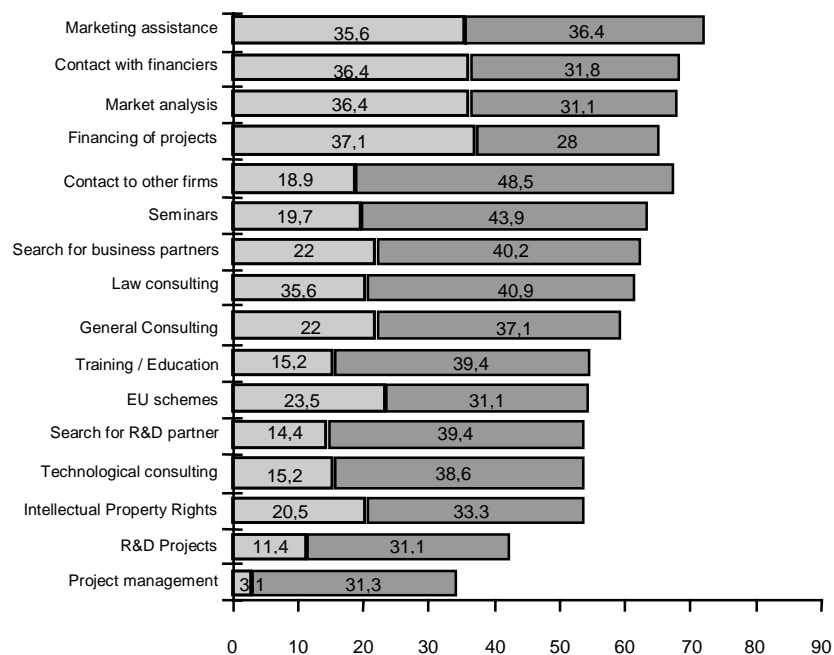


Figure 2. The companies' needs for innovation support services.

Table 1. Dimensions of NTBFs' needs for innovation support.

	Technology	Marketing	Finance	Soft services	Community
Realisation and management of R&D projects	0.77				0.60
Technological consulting	0.79				0.63
Search for R&D co-operation partners	0.79				0.62
Contact to other firms		0.64			0.42
Market analysis		0.83			0.69
Search for business partners		0.65			0.43
Marketing assistance		0.83			0.70
Contact with financiers			0.87		0.76
Financing of innovation projects			0.94		0.88
EU schemes			0.66		0.43
Seminars				0.84	0.70
Training and education				0.88	0.79
Business consulting				0.75	0.56
KMO*	0.67	0.59	0.54	0.65	
Explained variance	61.6%	55.8%	68.9%	68.2%	

* Kaiser, Meyer and Olkin test.

analyses. The resulting factors are technology, marketing, finance and soft-services.

As Figure 3 illustrates, we could identify four factors of needs for innovation support services, which are of high consistency and statistical significance. We refer to these as 'needs bundles' as they form the basis for structuring and explaining the needs of small and medium-sized technology-based companies.

The existence of the needs bundles for technology-related services, market-related services and finance-related services has been identified by us in previously performed projects like the RITTS in Northern Sweden (cf. Maier and Heydebreck, 1996). It has been shown that these needs bundles are typical for SMEs in general, as can be seen in this study as well. When analysing the different Teknopols, we found one additional needs bundle, which we consider as typical for companies regarded as target groups for different Teknopols. This bundle of soft services comprises general networking and education. It refers to the expressed needs of small companies to be introduced into a network of contacts by a mentor or to increase

their know-how by visiting seminars and information events.

Technology-related services

Needs Bundle 1 consists of technology-related services for companies that experience a discrepancy between their strategic goals and their actual technological standing. Typically companies which express a need for one type of technology support service do so for another type as well. On average about 15% of all NTBFs express high needs for technology support services and some 50% express at least limited needs for technology support services. The exact figures for the individual services are provided in Figure 4.

Additional external resources for development projects as well as support for an efficient R&D project management are crucial prerequisites for technical innovation success that often surpass the scope of a small company. Support for the search and selection of suitable R&D co-operation partners as well as profound technological consulting are necessary fac-

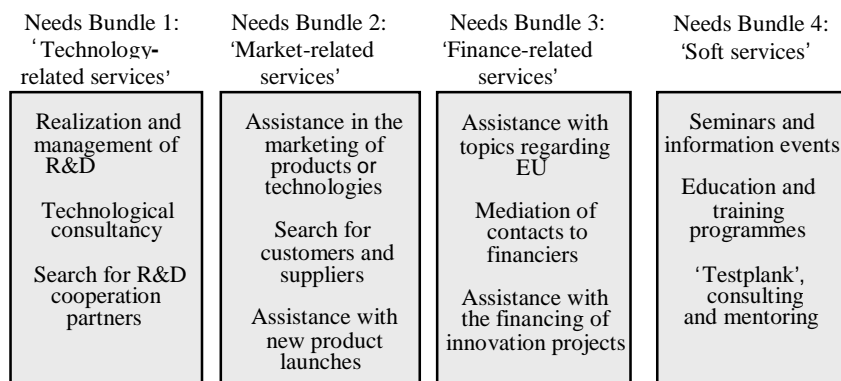


Figure 3. Needs bundles for innovation support services.

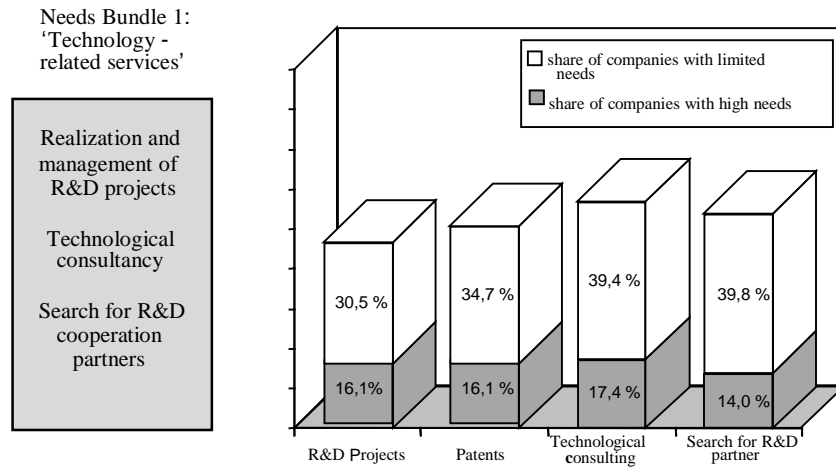


Figure 4. The companies' needs for technology-related services.

tors for the successful implementation of a development project. Even though offering just one of these services might be helpful, the full benefit arises from offering the complete bundle. This is due to two reasons: first, companies do encounter problems without always knowing which particular service is needed to help them. In these cases a provider, which serves a range of different technology support functions can assist in the definition of the problem and then quickly help without mediating further. Second, in many cases it is meaningful to make use of a portfolio of services simultaneously, which is much easier if they are provided out of one hand. Consequently, these services should be available out of one basket. This holds true for all companies with a need for external technological resources: for firms needing the resources to enable them to regain their competitiveness as well as for companies needing the resources to either build up or maintain a leading position.

Market-related services

This bundle is the one for which the companies express the greatest need. Actually the diagram displays a rather conservative picture of the companies' needs, as many firms do not adequately realise the necessity of increased market-related activities and consequently do not express them. The actual needs are therefore likely to be even higher. Among NTBFs, this under-estimation of the needs for external competence is particularly high in respect to market-related services.

Turning a technological innovation into a market success is a must in order to guarantee the company's survival. Nevertheless, many technology-oriented companies experience severe difficulties in the field of effective product marketing and despite their often very advanced technological standing such companies are still in need of external support and resources to

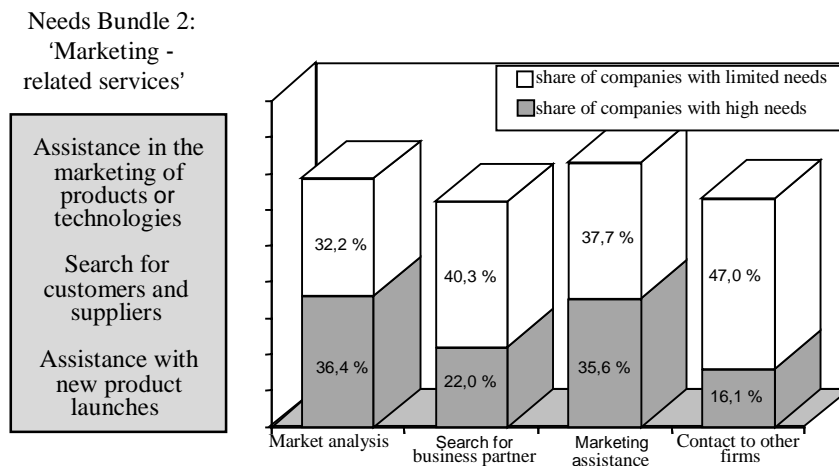


Figure 5. The companies' needs for market-related services.

convert their potential into economic innovation success.

Not too surprisingly, more than a third of all NTBFs express high needs for market analyses and marketing assistance for new products and technologies, more than two thirds experience at least limited needs for external support services. The share of NTBFs, which has high needs in respect to finding partners, is somewhat smaller,⁷ but the share of NTBFs, which at least expresses limited needs, is very high (above 60%).

Finance-related services

The bundle of finance-related assistance services includes direct financial support as well as support in detecting and accessing external sources of financial means. Support can consist of mediation of contacts to financiers as well as assistance with European Community support schemes. As NTBFs do not have the chance to build up equity capital by making profits in their first operational years, banks regard them as risky customers and are quite reluctant to grant them loans. This phenomenon leads to an especially high need among NTBFs for financial assistance services compared with more mature companies.

On the whole, general assistance services are requested by firms which either have a need for services attached to financial support or for general assistance in the form of services, such as information regarding various support programmes (e.g. EU programmes and development of business plans). As Figure 6 illustrates about 60% of all NTBFs declare a need for financial support services, be it direct financing or help in accessing third party money.

Soft services

In addition to specific expert support in the fields of technology, finance and marketing, NTBFs in particular have a need for a more general type of support service comprising, for example, raising awareness of unrealised needs, strategy advice, support in establishing efficient relationships with external actors⁸ or legal consulting services. The percentage of NTBFs which state high needs for soft service support is quite low (clearly below 20%). However, nearly half of all NTBFs express at least a limited need for soft services. Teknopols can meet these needs by providing training and education, offering mentoring services or referring their clients to adequate external partners. This bundle provides bridging functions, allowing companies to enter networks of experience, to overcome existing barriers and utilise the available external innovation support services; these services can be called 'network services'.

In order to satisfy the company needs, the Teknopols must be well-known entry points with a good reputation. NTBFs should turn to the Teknopol when they are unaware of whom they should approach. The companies appreciate the provision of soft services, recognising that they impact strongly on their capability to understand their real needs and to efficiently integrate external support services and resources into their innovation processes. Whereas the needs bundles technology, finance and marketing are relevant for all types of companies, soft services are particularly important to the target companies of Teknopols, namely NTBFs. This bundle helps to overcome the barriers of poor motivation to deal with urgent challenges and inadequate access to external know-how and resources because of a less developed reputation.

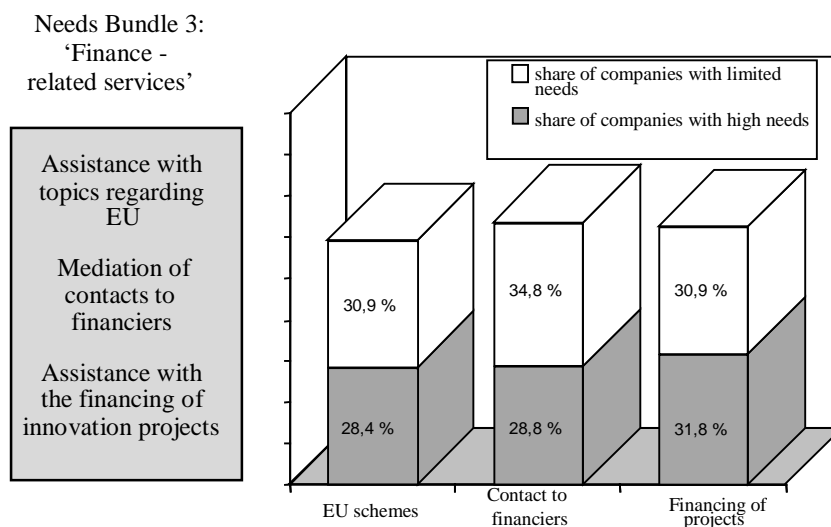


Figure 6. The companies' needs for finance-related services.

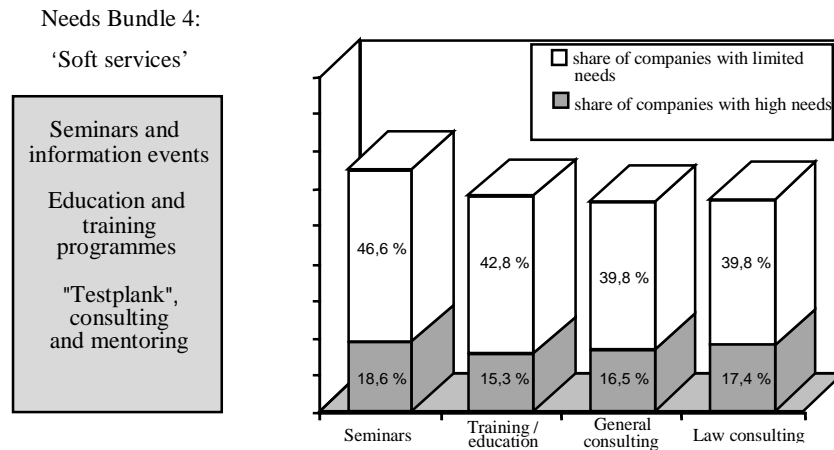


Figure 7. The companies' needs for soft services.

Conclusions

The conclusions presented below are based mainly upon the face-to-face interviews with representatives of 35 NTBFs but experiences from other projects are also taken into account. The study of the Swedish Teknopol approach provides lessons for two groups of actors or agency: on the one hand, the providers of innovation support services and the fosterers of an effective innovation supportive infrastructure; on the other hand, the managers of NTBFs.

Innovation supportive infrastructure

Overall, the Teknopol scheme can be regarded as good practice in satisfying NTBFs' needs for innovation support services. The scheme is both effective and efficient (Heydebreck and Maier, 1997). In the following the three primary conclusions for the innovation supportive infrastructure are dealt with in more detail.

- (1) Increase needs orientation of services offered. Support the innovation process as a whole from idea generation through to commercialisation of the technical success.

Support of innovativeness is often understood as merely promoting the transfer of technology from research to industry in order to increase a firm's technological innovation success. There is a lot of empirical evidence, though, that technological innovation success is no guarantee for commercial innovation success, only the latter securing jobs and incomes. SMEs especially face enormous difficulties in successfully commercialising a technical success. Their distribution channels, marketing know-how and financial resources needed to run, for example, a marketing campaign, limit their marketing activities. NTBFs primarily experience needs for soft services (mentoring, network competence, raising awareness) and marketing (search for partners, market potential analyses).

Generally, we recommend making systematic use of entrepreneurs' and industrial experiences in pre-testing and evaluating support schemes and services. This improves both the quality and the acceptance of support measures.

In order to cover the costs of innovation, NTBFs are forced to market their products throughout the country, in the whole EU and even outside the EU. Specifically spin-offs from universities and research institutes are very often inexperienced in (international) marketing. They need assistance in defining strategies for internationalisation and establishing an efficient network. In general, the Teknopol have managed to adapt well to the NTBFs' needs; this success is very much due to their flexibility of approach and, in addition, their close personal interaction with target groups.

- (2) Increase needs orientation of the process of delivering services.

On the delivery level, it turns out that neutrality, autonomy and continuity are necessary pre-conditions for NTBFs to build up trust towards a specific support actor. The authors, therefore, see the necessity to offer entry services (low risk, low cost) to solve limited problems of SMEs. In small first-step projects, the companies can benefit immediately and learn about the potential value of a wider collaboration with technology providers and intermediaries, without having to risk a lot of money or invest a lot of time. The staff of the industrial companies become familiar with the individuals from the external partner, personal bonds are established, and trust grows. Trust is necessary to overcome the cultural and language barriers that exist between highly sophisticated and specialised researchers and managers working on ordinary business challenges. Once a trustful collaboration is established, SMEs become more willing to exploit the potentials of a more intensive co-operation with innovation support providers. Also, pro-activeness is greatly appreciated

by entrepreneurs and NTBFs. Many of them realise that they do not know which questions to ask and would welcome activities for raising awareness of unrealised needs.

The establishment and maintenance of inter-organisational relationships is a time- and money-consuming investment process. The co-ordination of different relationships is a demanding management task. Thus, it is neither useful nor possible to continuously expand the network. The companies' response to the challenge of increasing need for external resources and the phenomenon of high costs of relationship management has initiated a trend towards conscious portfolio management of relationships. Increasingly, companies try to collaborate with single-source suppliers or few system suppliers. Important partners are asked to enlarge their range of services and products, relationships with marginal partners are terminated.

The suppliers of innovation support services and resources should develop their competence as system suppliers. If they are not in a position to do this then they have to intensify their networks with suppliers of complementary services. Companies typically need a whole bundle of services in order to solve a specific problem. This means that either one actor must be willing and capable of providing all services necessary to tackle the problem successfully on his own, or that the actor must know which services he can provide and who provides the others. He has to initiate contact between his customer and providers of complementary services. In order to do this efficiently he must be very well aware of the services offered by regional agencies and establish a dependable network with complementary service providers.

In general, the Teknopols have managed very well in delivering their own competence and the competence of their partners to NTBFs. Teknopol staff meet with their target group companies on a regular basis (lunchtime seminars, pub evenings, bilateral discussions etc.). However, it has to be recognised that the success of a Teknopol is very much determined by the individuals who drive it; retired directors of large multinationals typically do not fit in the scheme, because they are likely to have difficulty understanding NTBF needs and getting their trust. This holds true not only for the Teknopol staff itself but also for mediated partners (e.g. mentors). The great emphasis on personal contact limits the amount of clients a Teknopol can actually serve, because neither can one person maintain too many contacts nor should a Teknopol become a huge inflexible organisation.

(3) Increase the transparency of available services

Entrepreneurs and NTBFs are confronted with a jungle of support actors, many of them not having the necessary critical mass. Simultaneously, NTBFs simply do not have the resources for performing a

thorough analysis on who is best suited to deliver the services that they need. The NUTEK concept of carefully selecting high performing actors leads to a quite clear-cut situation. The seven members of the Teknopol family are provided with the necessary financial resources and decision power to flexibly react to the regional companies' demands. Also, the brand name Teknopol creates a trustworthy image.

Intransparency constitutes the most harmful barrier to an intense and efficient inter-company interweavement and company-technology institution interweavement. Since companies do not know which actor controls which resources or offers which services, the establishment of technology-based relationships is blocked. Companies (particularly SMEs) are reluctant to perform extensive searches for sources of complementary know-how and resources in order to identify a matching partner and motivate him to collaborate. Partner search is costly and an investment with risky paybacks.

We think that it is much more efficient for the providers of innovation supporting services to work hard on increasing transparency rather than for the target companies to be trained in network management. They can do this, for example, by intensifying the network of innovation support actors and to enabling all regional actors to initiate direct contacts between their clients and the most suitable technology institution. Overall, the Teknopols have not achieved the creation of a transparent infrastructure. This is not too surprising as this can only be achieved in a joint effort of all relevant regional actors. Today, the RITTS projects – which in Sweden are often strongly influenced by the Teknopols – have at least led to improvements (e.g. in the case of Southern Sweden).

The management of NTBFs

Entrepreneurs and NTBFs themselves can contribute to a higher degree of need satisfaction by considering the following guidelines:

- (1) Actively approach support actors and determine their specific capabilities. Be selective in the actors you approach, e.g. ask other companies about their experiences and the reliability and quality of specific support actors.
- (2) Map and weigh your problems. Be more self-critical and aware of your limitations. Factors that are crucial should not necessarily be handled internally but by the most relevant actor.
- (3) Develop a holistic approach to increase your internal competence and to integrate external competences and resources. Do not always prioritise urgent business over strategically important matters.

- (4) Actively support relationship promoters in your company by granting them spare time and resources for the initiation and maintenance of relationships.

The above list is by no means complete, indicating that a lot of research remains to be done on the success factors that stimulate the foundation and growth of technology-based firms.

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Notes

1. Cf. e.g. Roberts (1991) and Timmons (1985).
2. The scheme of Regional Innovation and Technology Transfer Strategies and Infrastructures (RITTS) is an initiative of DG XIII/D of the European Commission (see Heydebreck and Arnold, 1998; Maier and Lindholm, 1998).
3. See Bräunling (1990) for a description of the slow process from a strong technology-push driven technology policy towards a more needs-oriented innovation policy.
4. The totality of all actors supporting firms' innovation processes is called innovation supportive infrastructure.
5. See Gemünden and Heydebreck (1994) and Heydebreck (1997, pp 205–208).
6. We have employed qualitative analyses of the impact of providing support on company success. Consequently, we have not been forced to use a single standard definition of success. Instead success in some cases means increase of turnover, in others increase of profit

in others the technical solution to an urgent problem. In all cases we have applied the companies' understanding of success.

7. 22% of all NTBFs express high needs for support in searching business partners and still 16% experience

high needs for support with contacts to other firms in general.

8. See e.g. Hakansson (1987) and Hakansson and Johanson (1990) for a discussion of the crucial importance of an adequate network position for innovation success.