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Knowledge Intensive Business Services: A Second National Knowledge Infrastructure?

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Abstract

This report analyses “technology-related knowledge intensive business services” (T-KIBS). We start by defining which service sectors we include in this group, and go on to describe these services in the Norwegian economy and their role in a national knowledge infrastructure. Finally, we point out some implications for public policy aiming at improving innovation performance in Norway.

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Knowledge Intensive Business Services: A Second National Knowledge Infrastructure?

1. Introduction

In the following we will try to sketch a group of knowledge providers that possibly represents a very important alternative to the traditional knowledge providers in the public knowledge infrastructure. Service companies with highly educated staff which provide intermediate services in the form of knowledge intensive solutions for customer - what we would like to define *as knowledge intensive business services (KIBS)* - has a role to play in a policy analysis of Norwegian knowledge infrastructure and national innovation system (NIS).[1] That is what we are going to show in the following.

T-KIBS

In this study we will like to draw on a conceptual development which seeks to describe some more specific activities within KIBS; those services which are clearly *technology-related* - what we describe as *T-KIBS*.

"T-KIBS" represent certain economic functions that arise as more and more important in the so called "knowledge-based economy", functions that increasingly are performed by specialised business service firms rather than in-house in industrial enterprises.[2] In statistical terms[3] these business services are first and foremost:

- "computer and related IT services": NACE 72
- the private part of "research and development": NACE 73
- "architectural and engineering activities and related technical consultancy": NACE 742

[1] Miles et. al. (1995) distinguish the following criteria for identifying KIBS:

- KIBS are private companies and organisations
- KIBS rely heavily on professional knowledge, i.e. knowledge or expertise related to a specific (technical) discipline or (technical) function domain
- KIBS-firms provide intermediate, often knowledge-based products and services

[2] It would of course be wrong to claim that these services are all new; e.g. architects and lawyers have been organised as important business service industries for a century. Still, it is not longer bold to state that the growth of information technology and an increasing separation of different business functions in enterprises has led to knowledge intensive business services being a very significant part of western economies today, both in terms of economic output *and*, as we will discuss in this paper, as knowledge and innovation mediators for the rest of the industry.

[3] The statistical categories we here are applying are within the EU's so called *NACE Rev.1* standard.

♦ "technical testing and analysis": NACE 743. [4]

In Norway these T-KIBS represented a total sales of ca. **35 billions NoK** in 1993, and employed approximately **45 000** people. In general, business service firms in Norway are small. Two thirds have less than 5 employees and 85 % less than 10 employees. The T-KIBS are on average somewhat bigger than this, with a few very large companies among the typical 5-10 employees architect or consultant partnerships. The industry has experienced a continuos growth since 1990, both in sales and employment, with a real takeoff in 1996, especially the IT-related services.[5]

We have however tried, by testing through interviews with industry experts and key-people, through what we believe is representative case-studies, and through more quantitative data, to illustrate how these services influence the distribution of scientific and other business knowledge relevant to the innovation capability of Norwegian industry.

Previous tests of these services' importance for industry on a macro-level are hard to find.[6] Typically there exists some "self-assessments" of consultancy services requested by big public customers, leaving the consultants to explain why they are so important. Moreover reports and evaluations of these services

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[4] Adopted from den Hertog and Bilderbeek, 1997 (forthcoming). They also speak of "potential" T-KIBS, which are:

- Technology related publishing: part of NACE 221
- Wholesale in machinery, equipment etc.: NACE 516
- Logistic services and related transport services: NACE 632
- T-KIBS in telecommunications: part of NACE 6420
- Patent bureaus: NACE 7411.5
- Technology-related market research: part of NACE 7413
- Technology-related economic and management consultancy services: 7414
- Technology related labour recruitment and provision of personnel: part of NACE 745
- Technology related training: part of NACE 8042, 8022 and 8030

These are not treated in the current discussion,. However most of these categories have been verified as important T-KIBS in other studies by the STEP-group (forthcoming publications related to the European Commission sponsored *SI4S*-project).

[5] It is however very difficult to measure and tell anything about to what extent these sales figures indicates the level of embodied technology-related knowledge transfer from these T-KIBS to the rest of the Norwegian industry.

[6] It has to be stressed that lack of data on the provision and importance of T-KIBS makes it difficult to formulate good policy advice. This is illustrated by the following statement from the OECD-report *Technical Engineering Services* (1990), p.56:

"Many documents studied from OECD countries did not distinguish between *science* (fundamental research), and engineering services for the diffusion and application of that research. Where TES [technical engineering services] is distinguished as a form of provision, the general agreement on the importance of engineering services is not matched by either statistics on the extent of provision of those services, nor by studies quantifying that importance.

(and again especially consultancy) tends to be focused on one specific client-relationship and project, which either is seen as a grand success, or condemned as "a failure and waist of money" by ether customers, the public or politicians[7]. Existing reports do in other words leave us with little possibility to asses the "true" value of these businesses' efforts in generating and distributing innovative knowledge on a national level, and thus difficulty in producing policy relevant analysis.

We have used some information from industry organisations such as the Association of Consulting Engineers (Rådgivende Ingeniørers Forening) as well as public institutions such as the SND (Norwegian business development fund) and the Ministry of Trade and Industry which to some extent use these T-KIBS in their total national business development policy. These reports do quite clearly suggests that even though Norwegian SME's are usually seen as no big spenders of expensive engineering and consultant services, business development and industry changes with support from government requires a high level of supporting services from T-KIBS in order to enable a sustained profitable business. The reason why, is by people in SND described as relatively simple: "modernisation of industrial production requires new scientific and technological knowledge that partly has to be acquired from outside the firms and put in place by experts".

A national innovation system

Institutions such as universities and research institutes which *creates* scientific knowledge for national industry, obviously have a special position in the mapping of a unique national knowledge infrastructure. But at the same time it is evident that the *distribution* of knowledge makes up a complex system in itself. This "web" of mediators with its particular relations between *network actors*, is a distinctive character of any *national innovation system* (NIS)[8]. The national knowledge infrastructure as seen from the so called NIS perspective, must also include the *distribution* and *implementation* of produced knowledge in business, through innovation. Thus we might claim that the *helpers* - just like transport services in the more traditional infrastructure - that can put knowledge into action, constitutes an important part of the knowledge infrastructure and should be included in national innovation policy.

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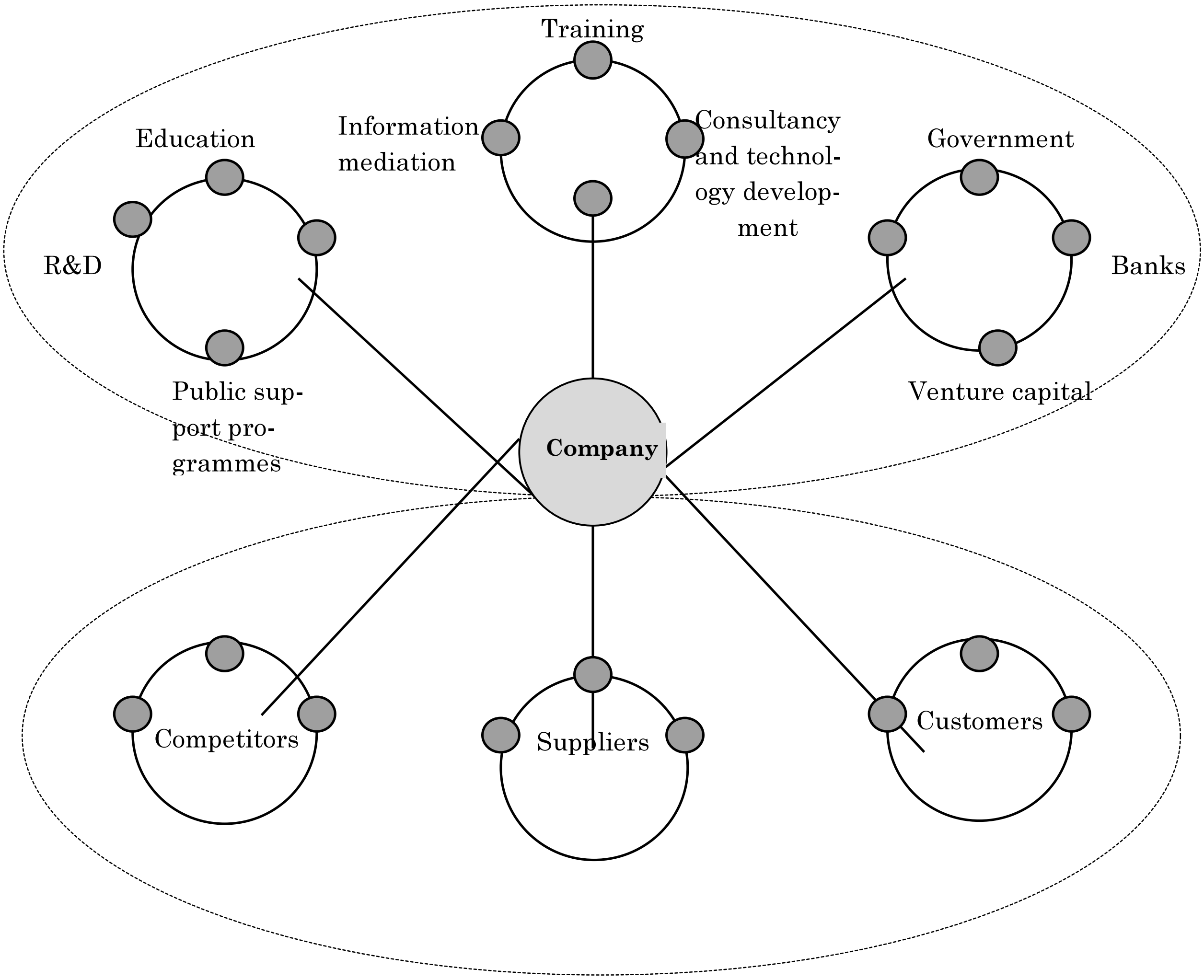
[7] A typically example in Norway as elsewhere in Europe for the moment is huge and expensive consultancy projects introducing new tailor made IT in public sector by, which goes all wrong.

[8] For an elaboration of network actors in relation to national innovation systems, see Bell and Callon 1994.

Figure 1: Knowledge infrastructure in a NIS-perspective.



Hence the following attempt to describe professional mediators of knowledge and their importance for innovation performance in Norwegian industry and services, with a special emphasis on the technology-based knowledge intensive business services represented by the *consulting engineering* sector.

2. T-KIBS' role as knowledge diffusion agents

"Generating and diffusing knowledge is what we do for a living."
Manager in a Norwegian consulting engineering company.

In a forthcoming book (Miles et. al. 1997), den Hertog and Bilderbeek states two bold hypothesises concerning the role of T-KIBS in the public knowledge infrastructure. First they claim that; "…(technology based) knowledge-intensive business services (KIBS) will gradually develop into a "second" public knowledge infrastructure, partially complementing and partially taking over the intermediate role traditionally played by parts of the ("first") public knowledge infrastructure." In the same lines they continue suggesting that "…the traditional distinction between public and private knowledge-based (advisory) services will gradually disappear."

Many governmental programmes directed towards innovation in industry uses T-KIBS in attempts to build up an intermediary infrastructure for increased flow of knowledge about technology and business processes. In Norway the so called "BUNT scheme" is one of the more significant initiatives that has been taken, promoting training towards more effective interaction between SME's and typical knowledge brokers, such as T-KIBS.

Similar initiatives have been undertaken in 18 other OECD countries, with some 80 000-90 000 SME's being involved per year (in total) and a public share of funding between 50% to 75% of implementation costs.[9] On a super-national level, the European Commission's MINT-programme (Managing the Introduction of New Technology) is likewise an initiative for use of specialist innovation consultants as mediators of technological knowledge through national programs in many of the member countries.

Typical T-KIBS as engineering and consultant companies are of course one of several types of "bridging institutions" between institutions representing the national science knowledge bases and users in different industries. As den Hertog and Bilderbeek (forthcoming 1997) points out, industry technology centres, university transfer agencies, innovation centres (e.g. within governmental programs as mentioned above) and others do also play an important role in the national knowledge throughput. In the Norwegian case, it seems that, besides the direct links between industry and the well developed research and technology institute sector (which' importance for Norwegian innovation capability is indisputable), the engineering firms and small consultancies play a major part in the diffusion of knowledge to businesses. This is not the least because of the offshore and hydropower industries' size and special knowledge requirements in Norway.

What knowledge?

When bringing in knowledge intensive business services in a study of national knowledge infrastructure, the question concerning *what* type of knowledge we

[9] For a full listing and analysis of these programs see OECD report *Boosting Business Advisory Services,* 1995.

are talking about necessarily appears. In studies applying a national *innovation* system approach, it has been common to focus *scientific knowledge* which relates to technological innovation. This is an important task, which also has been a prime goals for this book. But it is important to acknowledge that a large part of even the public knowledge infrastructure is dissemination of innovation relevant knowledge which originates from elsewhere than natural and technical sciences. Innovation is more than introduction of new technology, and even new technology requires e.g. advancements in organisational knowledge. (Hence business schools and social science departments are also important parts of the public knowledge infrastructure.) KIBS like e.g. consultancy draws on all these different sources of knowledge and transform them into what we might call "applied business solutions".

KIBS specialises broadly in three types of knowledge, according to a report from the KISINN research consortium (KISINN, 1995);

- *technical,* such as computing, scientific and R&D.
- *managerial,* e.g. financial advice, market research and management consultancy.
- *professional,* which includes services such as legal advice and real estate business.

Without ignoring this diversity of innovation-related knowledge absorbed by customer industries, *technical* knowledge will still be the main issue in the following.

T-KIBS and innovation

Returning to the role of T-KIBS, there are good reasons to believe that services such as consulting engineering have a central position in the distribution of innovation and technology related knowledge within leading industries of the Norwegian economy. This is particularly true for the hydroelectric-power and oil and gas industries. Looking at numbers from the 1993 Community Innovation Survey (CIS) for Norway gives quantitative evidence (STEP-working papers 6-15, 1995): When asked to rate where new technology originated from, 11% of respondents in Norwegian manufacturing companies answered "through consultancy services"[10]. Further, 3% answered "through out-sourced R&D", which also belongs to T-KIBS.[11] Even more, the single most important source of new technology in the CIS - "equipment purchase" (17%) such as e.g. information tech-

[10] We do of course here assume that those consultancy services where technology oriented (since they where sources of tehchonology) and hence T-KIBS.

[11] We are assuming that contract R&D mainly is performed by private R&D institutes. The assumption is in anyway not of crucial importance for the reasoning here.

nology - to a large extent involves T-KIBS.[12] T-KIBS thus ends up as the overall most important suppliers of new technology to Norwegian industry.[13]

Other results from the CIS such as "share of firms rating different information sources as important for innovation" shows that consultancy services are as important as information from universities and higher education. T-KIBS are actually also reported to be of far greater importance than public R&D institutions, even though these have a special position in Norway compared with most other OECD countries (as is shown through several of the industry studies in this book).

Another survey by the Norwegian Centre for Research on Economics and Business Administration (SNF) further underlines the importance of private knowledge suppliers: When asked which supplier of consultant services and/or external courses they used the most, none of the reported institutions belonged to the public sector (Nordhaug & Gooderham et.al. 1996).[14]

Another important reason for taking T-KIBS into account as mediators of innovative knowledge in the Norwegian economy, is the fact that they deliver a substantial part of their services to other business service firms (as is generally the case in Europe)[15]. Business service firms are not asked about their knowledge sources in the manufacturing-only CIS and its measures of KIBS as innovation mediators, and consequently undermines their overall position. For services in general, T-KIBS seems to be much more vital deliverers of knowledge than institutions in the public knowledge infrastructure, and services constitutes a major part of total production in the Norwegian as any other OECD economy. Hence, again we see that T-KIBS are major knowledge mediators for the overall economy.[16]

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[12] An increasingly important part of this is tailor made deliveries by specialised wholesale and retail traders, often with substantial "knowledge packages" to go with it.

[13] Now to what extent this technology transfer implies embodied *knowledge* transfer which can be counted as a part of total NIS knowledge distribution is a difficult discussion. However we would claim that the "knowledge package" that "new technology" comes with today, is rather underestimated than overestimated in a world of business managers and industrial policy makers that still mainly talks about the *tangible* rather than intangible investments' importance for economic performance.

[14] While as the above figures and facts represents the national industry in general, the use of knowledge sources does of course varies greatly from industry to industry, forcing us to look more carefully at selected sectors. (As mentioned above we will especially devote some place for analysis of consulting engineering within petroleum offshore industry.)

[15] "More than half of the services provided by engineering and other technical consultancy firms…are used by business services" in the Netherlands (den Hertog and Bilderbeek, forthcoming 1997).

[16] This is of course in no way an attempt to underscore the fact that also service industries, including T-KIBS, totally depends upon public education institutions and other public knowledge infrastructure. It is however an attempt to also move beyond this basic level of analysis.

Lack of other reliable sources of information on the use of T-KIBS by Norwegian industry and, equally important, their value as knowledge sources for innovation activities in industry, does however make it difficult to "prove" their importance.[17] It should be noted that findings from other countries, notably Denmark, question their role as "knowledge mediators" and "change agents", as the majority of respondents in surveys and interviews stress that regular *suppliers* are preferred as advisers because they increasingly possess a specialised technical knowledge that the (to generalist) private technical advisers often lack (Norvig Larsen, 1996).

R&D in T-KIBS

R&D in its traditional sense is simply less important for innovation in T-KIBS than in most other knowledge/technology intensive manufacturing industries. This does of course to some extent relate to the fact that - as pointed out by Hauknes and Smith (1995) - "the long term strategic 'vision'" of the very customer oriented T-KIBS companies often can be limited. This, in combination with lack of financial recourses and the general high uncertainty in technology development business, creates difficult conditions for R&D expenditure in T-KIBS companies' budget negotiations. But more important even, is the fact that these kind of services' innovative efforts are simply not defined as R&D.

It is a typical feature of T-KIBS client oriented technology development, that the R&D statistics for the sector to a large extent refers to contract R&D carried out on behalf of other industries, as distinct from R&D carried out to enhance the sector's own capabilities. Thus the whole discussion of national knowledge-bases and T-KIBS inevitably largely will touch upon the T-KIBS as knowledge producers and distributors them self, as opposed to the analysis of other industries use of knowledge in this book.

However, if we open for a broad definition of R&D to include intangible investments at large (or maybe rather change the whole term to innovation investments?), we observe that T-KIBS are spending relatively much. Intangible investments - termed "the soft side of innovation" by den Hertog, Bilderbeek and Maltha in *Futures* (1997) - include know-how and related investments in human resources/training (the most substantial investment over all in T-KIBS), certification of services, database development, software, design etc. But statistical data on these investments are not yet collected, making it difficult to provide alternative (to R&D) indicators for innovation strategies and policy.

Interactive learning

The distribution of knowledge naturally is a result of both the ability of knowledge creators to disseminate the knowledge *and* the ability of potential users to absorb it. Since these two processes very often can not be sharply distinguished from each other, one might claim that part of the answer as to whether the production and distribution power of knowledge-bases in a NIS is high or not, is to

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[17] Nordhaug (1991) rightly terms the private sector of suppliers of direct competence (as opposed to the indirect services by public institutions such as universities) as the *shadow system,* due to the fact that it to a very limited extent has been studied and made visible.

be found by investigating to what extent interactive learning between suppliers and users of technical knowledge is facilitated in different industries. For the "supply" of knowledge form most T-KIBS interactivity is crucial. This because the process of selling a knowledge service - which very often only can be specified accurately after it has been delivered - naturally requires a learning dialogue between supplier and customer in order to be successful at all.

The most classical problem mentioned as hampering the learning and knowledge transmission process is that T-KIBS deliver a "closed" knowledge which can be hard to distribute within the customer organisation. This is also related to the fact that customers rarely follow up e.g. consultancy services with internal technical groups to fully exploit what they have paid for. A perception of business consultants as somebody that comes and disappears swiftly taking some knowledge with them, and leaving a standardised and expensive product which is not to useful, is quite common in industry.[18]

Do T-KIBS them self buy services from other T-KIBS? Yes, research shows that the majority does (Jevnaker, 1996). Also, 55% of respondents among the consultants in this study reports that external training is an important way of updating knowledge bases. More surprisingly the study shows that 75% co-operate with competitors.

Not only the customers learn in the consultant/client-interaction: the experience-based learning that comes through project work for customers is reported as the by far most important source to updating of internal knowledge among consultants in the study by Jevnaker 1996.

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[18] The current debate in innovation literature on the question of *codified (or explicit) vs. tacit knowledge* (e.g. Nonaka 1991, Senker 1995, Foray & Lundvall 1996 and Cowan & Foray 1997) is highly relevant when discussing how knowledge transfer between consultant and customer occurs. To some extent the consultants job is to codify customers knowledge and extract knowledge of general relevance which feeds into own codified knowledge base, which in turn is used in interaction with customer-knowledge again, making these consultancy service transactions into learning cycles where ideally both parts benefits. In these interactive learning processes *tacit* knowledge might be just as important as explicit knowledge. How to deal with these to different types of knowledge when transfer of knowledge is the aim? This discussions importance for both corporate and public policy with respect to T-KIBS' role as knowledge diffusion agents should not be ignored, and is thus mentioned in the concluding remarks of this chapter.

2. Structure and dynamics of Norwegian T-KIBS

The general economic conditions for T-KIBS in Norway are quite good compared to most other European countries. This is mainly due to four reasons:

- Norwegian industry basically consists of SME's, and even the large ones are not that big compared with e.g. the largest French, British or multi-national companies. This implies that most industrial enterprises are not fully self-supplied with own engineering and technical services capabilities (it does not exists sufficient returns to scale to keep the capacities in-house), resulting in a relatively well developed externalised sector for these kinds of services.
- Further public purchases of such services have been an important reason for growth of the industry for the last 50 years. In many European countries this has not been the case; public utilities have provided these services them self.
- The development of the hydroelectric power sector as well as infrastructure in a demanding Norwegian nature has represented relatively steady home markets for such services.
- The industry has been well fed by the enormous demand of the petroleum and gas industry developments in the North-sea for the last 20 years.

In sum this results in a high relative number of people engaged in T-KIBS activities in Norway (as goes for Scandinavia in general):

Table 1: People engaged in T-KIBS per million inhabitants, 1990.

Denmark	1847
Finland	1812
Sweden	1011
Norway	**990**
Great Britain	792
Netherlands	727
France	513
Germany	509
Greece	431
Italy	384
Belgium	295
Spain	288
Portugal	199
Ireland	178

Source: Suomen Konsulttitomistojen Liitto Skol Ry, Finland 1992.

The development in the Scandinavian countries are actually quite in line with new European Commission initiatives to create more open competition in the European market for such services. Hence one might claim that the Norwegian T-KIBS should exploit their “first mover advantage” in increasingly open international markets. This has already been stated as a clear objective by the largest firms and by policy makers, and partly implemented by aggressive bidding on delivery of engineering and consulting services on huge hydropower projects in Asia, as well as export of offshore expertise in oil exploration projects all over the world.

The structure of consulting engineering sector in Norway

Even though the bureaucracy required by legislation is an important barrier to entry for consulting-engineering firms in Norway (notably in offshore related business areas), the industry mostly consists of very small firms, and this is decisive for its innovative activities. The structure and changes of technical knowledge services in Norway is to some extent determined by such factors as ups and downs in investment intensity among oil companies and general variations in construction industry activity.

The development of technical business services in Norway is first and foremost related to hydropower developments starting a hundred a years ago. An illustrating historical example is the development of what came to be the biggest Norwegian engineering consulting company at the end of the 1980's. Established in the late 1920's, the two competing consulting engineering companies *Berdal* and *Strømme,* both had hydropower as their main field of competence. After the 2. World war they both went into construction engineering, which has continued to be a main business area up until today. As the exploration of petroleum in the North sea started in the late 1970's, Berdal decided to develop knowledge and skills within offshore engineering. They also specialised in onshore rail and road infrastructure. Strømme on the other hand, increasingly took on municipal development projects, water and waste management, and environmental consulting. With prospects of decreasing markets in near future, the two companies merged in 1988.

In general, consulting engineering tends to suffer from cyclical upswings and downswings. Typically there are turbulent periods with high merger & acquisition activity and many people being led off from the biggest companies, followed by a slow reconstruction of the sector as free consultants starts up small entrepreneurial consultancies by finding alternative niches and building up business during new economic upswings. Some of these again are merged in to bigger companies, and so the cycle goes. A period like this took place in Norway from 1988 to 1992 due to reduced (onshore) building and construction activity and prospects of reduced activity in North Sea petroleum exploration (later invalidated). This affects the long run stability of the companies, and their ability to innovate.

In hard times there is, as indicated, generally a higher degree of business development, because people being led off seeks to employ them self through new self established mini firms. It is this sort of entrepeneurship which is the basic business idea behind the majority of the firms in the industry. They might take departure in a new idea of a service product and thus be innovative in that sense, but more often their strength is the offered personal expertise that has been gained through hands on experience as staff at one of the bigger engineering or oil companies. The innovative capability is therefore usually manifested in continual incremental innovation, typically providing special tools (and the expertise to use them), bottle neck solving and design of special parts for client.

Is then the more "radical" innovation initiatives mostly taking place among the few "bigger fishes" in this industry, or is this actually one of the industries where small firms innovate relatively more than the bigger ones? This is a question that will be investigated through further research (survey), but let us just mention that research already being done on the innovation ability of the kind of small firms that is created primarily to employ the owner (and possibly a few others), shows that these businesses are not usually very concerned about growth and new development, as they are into the market in order to secure personal income with the least of extra burdens (see e.g. Storey 1994).

Figure 2: Types of knowledge and main markets for Norwegian consulting engineers

		Offshore oil & gas industry	Ship building	Construction and Building	Infrastructure	Energy	Environment	IT
Core technological knowledge	Product development							
	Process development							
Knowledge Related to production and business operation	Production and logistic managmnt							
	Project management							
	Quality management							
Peripheral knowledge needs	Cleaner tech. and environment							
	Energy							
	Infrastructure planning							
	Architecture, technical measurment							

Even though it is perceived as a threat to important knowledge bases and accumulation of expertise, modification of the sectors "state of the art" skills and knowledge areas through up and downswings, can also trigger genuine innovative activity (and not only establishing of new firms). This because it forces the small entrepreneurial consultants to find new markets and closely follow new trends among potential clients which might represent a new upswing. Recent examples that illustrates this point is the developments of new services such as niches within "environmental consultancy", "quality education services" and the fast growing ICT-consultancy sector, explored by small consultancies that have acquired new knowledge and expertise ("new to the market") for the purpose.

Still, low barriers to entry during these entrepreneurial periods causes fragmentation, and, as mentioned the price cutting does in general reduces a firm's capability and incentive to invest in innovation. The quality of the services on engineering projects may also suffer and in extreme cases lead to "the winners curse", where firms bids below project costs and face losses that might be lethal.

4. T-KIBS in the knowledge infrastructure policy

1. In developing strategic policy towards T-KIBS driven innovation in general, it is crucial to recognise that knowledge has a public good component, which ties the T-KIBS' "second knowledge infrastructure" to the public knowledge infrastructure.
2. It is important to acknowledge the often strong economies of scale in the production and use of knowledge in T-KIBS. This further raises the question; can we apply different policies to manufacturing (i.e. oil companies) and service firms (i.e. engineering consultants) respectively, as long as the difference between their business activities are getting blurred with increased scale?
3. Markets handle commodities (in the form of objects) well, but they do not handle non-commodities (knowledge and information) with the same efficiency. Thus, the production of knowledge will create waste from duplication in a pure economic system of competition.
4. This results in firms engaging in filièrs or networks where knowledge clusters facilitate the use of "waste" knowledge, creating synergies between firms and sectors, e.g. as we have witnessed has been the case between oil-companies and consulting-engineering firms.
5. These filières are defining (region and technology specific) regimes within which innovation is taking place, and are thus constituting an important "medium" that can be acted upon by policy means, in order to improve innovativness of the involved industries.

It should thus be clear that we would like to stress the importance of developing and implementing models for supplier-producer-customer relations (networks) in offshore projects in order to stimulate knowledge transfer as well as making it easier for the smaller companies to develop their ideas into innovations through R&D joint ventures or other ways of financing. Examples that illustrate this importance can be found in e.g. export of knowledge intensive technological and service products: in order to take on large engineering contracts abroad it has become usual for Norwegian companies to join forces and deliver goods and services (such as hydropower or oil & gas installations) through long term or just project based alliances, making vertical integration a necessary way of responding to scale requirements as well. And example of a public policy measure that is applied to promote this, is the Norwegian state owned oil company (Statoil) and the Ministry of Business and Trade bringing along "clustered" technology suppliers to new oil and gas exploration and exploitation areas in the Persian Gulf and former U.S.S.R.

Coalitions and joint ventures between *competitors* is also a interesting option in industry policy. The most well known strategic partnership for export among consulting engineers in Norway is the company NorConsult (founded in the late 1950's) with some 15 parent company partners at the most. NorConsult has proved to be a strong pool of knowledge for export of engineering services and illustrates the possibilities of coalition strategies.

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STEP-gruppen ble etablert i 1991 for å forsyne beslutningstakere med forskning knyttet til alle sider ved innovasjon og teknologisk endring, med særlig vekt på forholdet mellom innovasjon, økonomisk vekst og de samfunnsmessige omgivelser. Basis for gruppens arbeid er erkjennelsen av at utviklingen innen vitenskap og teknologi er fundamental for økonomisk vekst. Det gjenstår likevel mange uløste problemer omkring hvordan prosessen med vitenskapelig og teknologisk endring forløper, og hvordan denne prosessen får samfunnsmessige og økonomiske konsekvenser. Forståelse av denne prosessen er av stor betydning for utformingen og iverksettelsen av forsknings-, teknologi- og innovasjonspolitikken. Forskningen i STEP-gruppen er derfor sentrert omkring historiske, økonomiske, sosiologiske og organisatoriske spørsmål som er relevante for de brede feltene innovasjonspolitikk og økonomisk vekst.

The STEP-group was established in 1991 to support policy-makers with research on all aspects of innovation and technological change, with particular emphasis on the relationships between innovation, economic growth and the social context. The basis of the group's work is the recognition that science, technology and innovation are fundamental to economic growth; yet there remain many unresolved problems about how the processes of scientific and technological change actually occur, and about how they have social and economic impacts. Resolving such problems is central to the formation and implementation of science, technology and innovation policy. The research of the STEP group centres on historical, economic, social and organisational issues relevant for broad fields of innovation policy and economic growth.