Innovation Patterns in KIBS Organizations: A Case Study of Finnish Technical Engineering Industry

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Abstract

The innovation patterns in Finnish engineering consultancies are analyzed in terms of service innovation types. The utilized typology of service innovations includes four dimensions: new service concepts, new client interfaces, organizational innovations and technological options. The empirical findings indicate that innovations in Finnish engineering consultancies mainly occur as client-led innovations and innovations through services. Typical examples of innovations are related to new organizational models and networks, which help working with the clients, and technology-based innovations, which can take the form of new software. Based on the analysis, we draw some preliminary conclusions about the general development needs in innovation patterns of the engineering consultancy sector. We also outline some potential directions for future studies.

1. Introduction

Innovation in services has been a topic of growing interest for researchers and policymakers since the 1980s. As the field of service innovation studies has become more mature, many significant results in the analysis of services and service innovation have emerged [1-3]. For example, it has been recognized that many service firms are not merely passive recipients of manufacturers' innovations, but are innovative in their own right. This is in contrast to the supplier-dominated view [e.g. 4-6], in which the service sectors are portrayed as receiving an impetus for the innovation process largely from manufacturing. Furthermore, there has been more emphasis on non-technological aspects of service innovations, such as the ways in which service production and customer interactions are organized and how existing service activities can be combined to create new services [e.g. 7-10]. So, instead of considering services as non-innovative, an alternative perspective is that services tend to innovate differently from manufacturers, or at least that innovation in services brings "softer" aspects of innovation to the fore [11]. All these new insights have resulted in a better understanding of service innovations and their management.

One of the important findings is that innovation in services extends beyond the service sectors to affect service activities in all sectors of the economy, and that there are certain services which transfer and support – and are a source of – innovations for other sectors [12, 13]. In particular, several studies have focused on the role of knowledge-intensive business services (KIBS) in the innovation system and it has been observed that the presence and use of KIBS indeed enhances the performance of economic sectors and regions [e.g. 14, 15]. For example, the case studies of Howells [16] show that contract R&D services are often actively involved in technical specification and product design for manufacturing firms. Moreover, since KIBS are seen to produce innovations and assist in spreading knowledge in the economy through their close relationship with their clients, many KIBS studies have been dominated by concerns about the knowledge interaction between KIBS firms and their clients [17, 18].

Despite the growing number of KIBS studies, there is still a need for more research work on innovation patterns in different sub-sectors. In fact, the specificity in which many research questions can be answered depends on what kind of business service is concerned [cf. 19, 20]. Here we focus on the analysis of innovation activities in Finnish engineering consultancies which provide different types of services, e.g. machine and process engineering, electrical engineering and project management services to their clientele. Even though innovations and knowledge production in the engineering consultancy sector have been studied earlier [e.g. 21-23], there is a lack of more thorough analysis of innovations in terms of their type. In this paper we will discuss the following types of service innovations in the Finnish engineering consulting sector: new service concepts, new client interfaces, organizational innovations and technical innovations.

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2. Service innovation types

Services are different from manufacturing, but inside the service sector there is a wide variety of different types of sub-sectors. This research focuses on knowledge intensive and technology-related business-to-business services provided by engineering consultancies, which can be very different by nature and different in their innovation-intensiveness from many other e.g. consumer-related services. Innovations in services can be analyzed e.g. on the basis of the degree of novelty, and different types and dimensions of innovation, as discussed in this chapter, which reviews the service innovation literature.

2.1. Novelty in service innovations

There are many challenges in the analysis of innovation in services. For example, Gallouj and Weinstein [24] point out that the theories of innovation have been largely developed on the basis of studies of manufacturing industry, so it is not clear whether they are appropriate for the service sector. They also note that the output of service activities is often analytically 'fuzzy', which makes it difficult to use the traditional economic methods to measure the productivity of services, or to detect improvement or change qualitatively. Moreover, since service innovations are more often non-technological or social than in manufacturing, they are typically small, practical adjustments of procedures – in other words more incremental than radical [25]. Sometimes it may indeed be difficult to draw the line between innovation and other types of change. When deciding whether a change is an innovation or not, considerate should be considered, for example, whether the innovation is "new to the firm" or "new to the market." As mentioned above, service firms are often considered to be "supplier-dominated", introducing existing innovations and technologies from other firms. "New to the firm" type innovations may not therefore always be categorized as "true" innovations. In some service sectors there is also a high degree of supplier-user interaction, which tends to make the products more customized than in other service sectors. Producing highly specialized services that are effectively new products for each client does not mean that each customized product (variety) is an innovation to the firm, however [see 26].

While there is obviously a continuum of novelty in service innovation – from minor, evolutionary adjustments to radically new ideas – some researchers have differentiated between different innovation types regarding the degree of innovation [e.g. 25]. For example, in a literature review of product innovativeness for new financial services, Avlonitis, Papastathopoulou and Gounaris [27] identify six distinct service innovativeness types, which can be represented in the form of a continuum depending on the degree of innovativeness. At the most innovative extreme of this continuum the authors put the new-to-the-market services, followed by new-to-the-company services, new delivery processes, service modifications and service line extensions. At the least innovative end the authors place service repositionings. They further observe that these six types are associated with different development patterns in terms of activities, formality and cross-functional involvement as well as performance outcomes. Similarly, de Jong et al. [2] point out that the degree of novelty will coincide with different types of innovation processes. They therefore argue that radical innovations are usually developed in large-scale, formally managed processes in which the development work is separated from the regular work processes, and project teams are responsible for the development efforts. Incremental innovations, on the other hand, are typically developed in less formalized processes in which development work and usual tasks are alternated. Since incremental innovations in services are far more frequent than radical innovations, it has often been argued that service innovations do not spend much money on research and development, or even require much R&D [28]. It has also been observed that since there is no need for research or collection of scientific knowledge, the development times for service innovations seem to be relatively short compared to product innovations [25].

Apart from the degree of novelty, service innovations can be analyzed along different dimensions. As noted above, an innovation may be new to the firm even though it is not new to the market – for example it may exploit a service concept which already exists elsewhere. Innovations that are new to the market, on the other hand, refer to the perception by new customers and/or competitors who are confronted with previously unfamiliar offerings [2]. Researchers have therefore studied different types of service innovations and proposed various taxonomies of these.

2.2. Dimensions in service innovations

Traditional innovation theories and typologies have mainly dealt with and distinguished between product and process innovations [e.g. 29]. This distinction is less suitable for classifying service innovations; however, since services have a process character and

the production process cannot therefore be completely separated from the (service) product. For example, there is often a close interaction between producers and customers in the service delivery process, and many services are in fact produced at the moment of consumption. Since it is difficult to change the product without changing the procedure, defining a clear line between the process and the product is not possible [10, 25].

The taxonomy of process and product innovations with variations and extensions is nevertheless often used in service innovation. For instance, Miles et al. [13] argue that in addition to product and process innovation, the delivery of the service to the client can be a site of innovation. Sundbo and Gallouj [25] in turn categorize service innovations into four types: product innovation, process innovation, organizational innovation and market innovation. In this typology organizational innovations refer to new general forms of organization or management, process innovations enhance the service production processes or delivery processes, and market innovations include e.g. finding a new market segment, or entering another industry and its market. Sundbo and Gallouj [25] further argue that "ad hoc innovation" could be added to this typology, as it seems to be important especially in knowledge intensive business services. This type of innovation is defined as the interactive construction of a solution to a particular problem posed by a client, so it is essentially "co-produced" by the client and the service provider.

Some other examples of service innovation dimensions can be found in Gadrey, Gallouj and Weinstein [30]. In their study, different types of service innovations are identified in three service sectors. First, in the insurance sector the authors observe 1) innovations in "service products" (a new formula for managing clients' problems), 2) architectural innovations (which bundle or unbundle existing service products), 3) innovations which modify the "service product" and 4) innovations in processes and organization for an identical (or almost identical) service. In business consultancy services the main categories of service innovations are product innovation, process innovation, organizational innovation, market innovation and a conquest of a new source of raw materials [cf. 25]. According to Gadrey, Gallouj and Weinstein [30] the last type of this "Schumpeterian" typology does not easily lend itself to the analogy in services, but could e.g. be a new source of employees to be recruited. Finally, in electronic information services the types of innovations are 1) the creation of a new product or new service (e.g. a new database, or a new mode of processing and utilizing information), 2) innovations in the improvement of products or services (such as adding new functions, improving conditions of access, or improving the content of the database) and 3) process innovations (e.g. new automated methods for retrieving information).

When discussing the applicability of service innovation typologies specifically in KIBS sectors, Nählinder [26] argues that KIBS firms can carry out technological process innovations, organizational process innovations and service product innovations. First, a technological process innovation means that the firm introduces a goods (physical) product innovation made in another firm and uses it to enhance the service production process. An example of this would be a new software program which enables a KIBS firm to make a process innovation (e.g. in technical design). Organizational process innovations in turn refer to new forms of organization of service production. Service product innovations in KIBS firms, on the other hand, can be seen as a source of innovations for their client firms. Nählinder [26] further notes that when KIBS firms develop service products, they often get ideas from their clients in the process of co-production and may also introduce them to other firms. She therefore emphasizes the role of KIBS firms as agents of innovation transfer between firms.

Finally, at a more general level, Van der Aa and Elfring [10] distinguish three main categories of service innovations on the basis of literature. The first category includes the innovation process or the 'new product development' process in a service firm, the second category is about the role of information and communication technologies in services, and the third category focuses on the various forms of innovation, especially organizational and technological innovations.

The above taxonomies clearly show that service innovations encompass several dimensions – besides product innovations researchers have identified various types of process innovations, organizational innovations, market innovations, service delivery innovations, and so on. It should also be noted that most service innovations appear to have characteristics of more than one dimension. In addition, den Hertog [17] argues that there are huge differences in the specific patterns of these innovations: for example, introducing a new service product into one market may have different requirements than offering the same product in some other market. In order to analyze the diversity of innovations in greater detail and in a structured way, den Hertog [17] proposes a four-dimensional model of service innovation: the service

concept, the client interface, the service delivery system or organization, and technological options.

The service concept: The first dimension is related to the content and characteristics of the new service. The innovation here is that although some service concept may already be familiar in other markets, it may be novel in its application within a particular market. Service firms often choose to imitate competitors' innovations, so changes in the service concept are an important source of adaptations [2]. Of course, if a product, function or concept is new only to the firm, the problem is determining whether it is an innovation at all. As an example of the service concept, den Hertog [17] mentions e.g. IT consultants who offer their client firms semi-standardized and incremental plans for implementing e-commerce.

The client interface: Since service products are increasingly produced and marketed in a client-specific way, the client interface is quite often the focus of service innovations. Innovations in this dimension are frequent also due to the fact that there is seldom a clearly identifiable point in service production where the producer's activity ends and the user's activity begins. According to den Hertog [17], this concerns especially business services in which clients partake in the service production process, and the service product itself offers support for the client's innovation. With this kind of high degree of co-production of services, it is sometimes difficult to locate the innovation within the service supplier or the client. For example, it is not unusual that service firms position their staff within client organizations for periods of time.

The service delivery system or organization: Innovation in the third dimension consists of adjustments and rearrangements in the organization form and service delivery system. This may include e.g. new internal processes that enhance the performance of the service workers and/or allow them to develop and offer new innovative services. Employee training and the development of (inter)personal capabilities and skills are among the means that facilitate innovations and non-conventional solutions to practical problems. As den Hertog [17] points out, this dimension is often directly related to the linkage between the service provider and its client (the preceding dimension), as delivery is one specific type of interaction across the client interface. One example of innovation in the service delivery system is the introduction of e-commerce, which may require considerable business process re-engineering.

Technological options: The fourth dimension concerns technological options in service innovations. Technology is not always a dimension, however, as the discussion above clearly shows that service innovations often do not involve technological innovations. Indeed, technology – especially IT –often has a facilitating or enabling role in the service innovation. Moreover, technology facilitates the maintenance of networks with customers and partners inside and outside the firm [31]. On the other hand, changes in technological options may also be forced by changes in the other dimensions. An example of innovation with a strong technological component could be a tracking and tracing system in transport services, which enables the service providers to manage their services more efficiently [17].

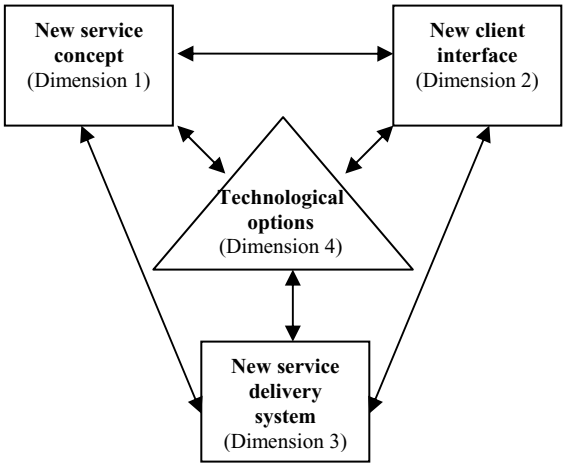

Figure 1. A four-dimensional model of service innovation [17].

As noted above, most service innovations are combinations of different dimensions of service innovation. For example, den Hertog [17] argues that developing a completely new service may require a new service delivery system, changes in the way employees work or relate to customers (the client interface), and modifications in the way IT is used in business processes. Moreover, a new service concept may also be involved. This makes it difficult to provide 'pure' examples of the above-mentioned dimensions.

Relationships between the four dimensions: Since many service innovations are combinations of different dimensions of innovation, it is important to recognize the possible linkages between them. In fact, people working in marketing, service distribution and organization development almost certainly have to deal with these cross-linkages: introducing a new service concept, for instance, requires marketing expertise, and

changes in the client interface require knowledge of the service delivery system. If a firm aims at improving cost efficiency, quality control, etc., the analysis of the relationships between the four dimensions becomes even more important. It is obvious that the weights of the individual dimensions, as well as the importance of the various linkages between them vary across individual services, innovations and firms. Also the inputs required to link the dimensions differ according to the type of service [2, 17].

3. Technical engineering industry

Due to the somewhat ambiguous use of the term KIBS in various studies, it has sometimes been difficult to evaluate their innovativeness and effects on the economy. It is therefore useful to first define what is meant by KIBS. In general, KIBS are defined as private companies or organizations relying heavily on professional knowledge, i.e. knowledge or expertise related to a specific (technical) discipline or (technical) functional domain, and supplying intermediate products and services that are knowledge-based [13, 17]. KIBS organizations can exist in several businesses and industrial branches: for instance Leiponen [32], who has analyzed the data from a survey of 167 Finnish KIBS firms, divides the studied firms into industrial design, advertising, machine and process engineering, electrical engineering, management consulting and R&D services. On the other hand, Wong and Singh [33] who have studied innovation patterns of KIBS firms in Singapore on the basis of a survey of 180 firms, focus on four main KIBS sectors; 1) IT and related services, 2) market research, business and management consultancy, 3) architectural, engineering, land surveying, and other technical, and 4) R&D, advertising, publishing, exhibitions and conferences. Miles et al. [13] make a distinction between two groups of KIBS. The first group consists of traditional professional services, such as marketing & advertising, management consultancy and accounting & bookkeeping, which are liable to be intensive users of new technology. The other group is new technology-based KIBS, including e.g. computer networks, software, design involving new technology, and technical engineering. The common factor for both these groups is that the KIBS rely heavily on the professional knowledge of scientists, engineers and experts of all types. They either supply products which are primary sources of information and knowledge to their users, or produce services as intermediary inputs to the knowledge generating and information processing activities of their clients [13].

Technical engineering firms (engineering consultancies) form a sub-sector of KIBS. They produce services which cover a wide range of often specialized and technology-based activities, including e.g. research, technical design, planning, consulting guidance and supervision, and varying aspects of project management. The application fields range from construction of projects related to infrastructure, buildings, and industrial plants to environmental assessment and information system development [23, 34]. There is also a wide variety of company roles, as projects vary from subcontracting to turnkey contracts. In short, technical engineering firms apply the existing technical knowledge and knowledge from earlier projects to the design of new processes and/or products according to their clients' requirements at different stages of the implementation of investment projects.

The sector of technical engineering services has a rather polarized structure. In Finland, there are over 6000 engineering firms, the majority of which employ less than five persons and only about thirty employ more than 100 persons. Most of the sector's turnover is also generated by a limited number of larger firms operating in a predominantly international market. Furthermore, small and large engineering firms have usually quite different focus in their activities: small firms typically operate on the basis of specialized knowledge and expertise in a limited domain and primarily serve a limited local market, whereas larger engineering firms often embrace a wider focus and undertake larger projects at home as well as abroad [34, 35].

The markets for engineering services are primarily related to the growth of their client industries, and business therefore tends to fluctuate with the cycles of growth and stagnation in major manufacturing and construction industries [35]. In recent years, also changes in market conditions and industrial structures have forced technical engineering firms to rethink the business models and mechanisms they use to respond to their customers' and other stakeholders' needs. First, the increased competition in the industry as a result of the depression in Finland in the 1990s led to lower profitability of projects, and this effect has been quite persistent in many firms. Also the increased outsourcing activity by major client firms has led to ever larger assignments and contracts, which only bigger engineering firms can handle. E.g. in the forest industry this strategy has forced engineering companies to diversify into new, related service activities [36]. For smaller engineering consultancy firms the central challenge is therefore to move to the networked business model, which would provide new opportunities in other market segments or in providing

broader service concepts. Furthermore, a recent trend in engineering consulting firms has been industry consolidation. Especially larger firms increase their size and number by strategic growth and mergers and acquisitions. The incentives behind consolidation include cost reductions and rationalization of operations, but also a need to acquire skilled engineers.

The internationalization of operations has been another recent trend. The internationalization has been achieved primarily via two different strategies: client following or market seeking. In other words, engineering consultancies have either followed their major domestic clients that have been carrying out projects abroad and have eventually expanded their international activities on the basis of such client relationships, or they have adopted market seeking strategies, i.e. seeking to expand their business in markets such as the fast-growing economics of East and Southeast Asia. The internationalization process for many firms has not been without difficulties, however. Firms have, for example, faced problems with their choice of co-operation partners, or the particular format of partnering or investing in foreign countries [35]. International operations also require knowledge of the local business environment and legislation as well as cultural differences.

All these changes in market conditions and new IC-technologies have forced technical engineering firms to develop new services and business models, as well as to rethink the organization of service production and delivery processes. In other words, there has been a real need in these organizations to innovate.

4. Innovation patterns in Finnish engineering firms

This chapter introduces observations from a larger empirical research project focusing on business development capabilities and service innovation in Finnish engineering consultancies. The data was mainly gathered during the years 2004 and 2005 by following the qualitative research approach. This research approach is grounded on observations based on an extensive literature review, which shows that even though there are several industry-level and regional approaches proving the significance of different service sectors, in-depth studies focusing on the various types and underlying procedures of service innovations in the knowledge-intensive service sectors are still relatively rare. The larger research project was conducted in close collaboration with four companies, but the data gathering through case studies, recorded in-depth interviews, as well as company-specific and inter-organizational workshops covered also several other organizations, which were involved with various types of innovations in the field. The empirical observations of different patterns and dimensions of innovation are presented and compared to literature reviews by utilizing an adapted den Hertog's [17] framework.

4.1. New service concepts

In Finland, there has recently been much discussion about the so-called "productization" of professional (business) services. This means that services and their production processes are more specific and more carefully designed, so that services can be seen as service products. Productization is then expected to lead to improvements in service quality and productivity, as well as in the management of the service organization [37]. Although engineering services are usually seen as unique, one-of-a-kind assignments, it has been noted that the idea of productization should also be applied to these. The rationale for setting the productization of services as one of the key areas of development for engineering consultants is as follows: since engineering firms are engaged in project based business, they gain know-how and experience from assignments, but not necessarily methods and knowledge that could be used in the future projects. Not all activities in engineering firms are unique, however, but many of the tasks are repeated in each assignment. The main objective of productization is therefore utilizing and re-using the know-how that has been gained from previous projects. Another major advantage of productization is that productized services can be developed in advance and marketed to the customers as well formulated service packages [37]. Although service packages and productization have already been introduced in many other business services, they are novel in their application within the engineering consulting sector and, as a consequence, can be seen as a new service concept.

According to a qualitative empirical study [38] conducted at eight expert organizations, transformation of services into products in the technical engineering and consulting industry is not very common, however. It is more common to improve and systematize processes and functions in the firm to improve operative efficiency. In some cases information gathered from previous projects is packed into computer programs to ease the realization of next projects. Actual productized services are usually supporting services rather than core services, as it is difficult to differentiate the core service from those of

competitors. Because of the rareness of transforming services into products in the technical engineering and consulting industry, the productization process itself is difficult to define, as stated by the company interviewees. However, some general, significant process phases can be recognized in the study. On the basis of the integration of theoretical frameworks and the results of the empirical study, it is proposed that productization process for the knowledge-intensive technical engineering and consulting firms can be divided into five main sections; 1) starting points (company values, strategies, objectives, culture), 2) forming of service products, 3) testing, 4) pricing and marketing planning, and 5) monitoring and development.

Services that have been "productized" in engineering consultancies are, as said, typically so called complementary services, which have first been developed and tested for the company's own purposes and then utilized and commercialized also outside the company. One example of these is e.g. a new service which promotes maintaining and delivering different types of technical documents.

4.2. New client interfaces

In the engineering consulting sector there is a close business relationship between the client and the engineering company. The client's input may also have considerable implications for the outcome of this relationship, which means that engineering consultancy must manage its customer knowledge and client interfaces effectively. One innovative solution for the customer knowledge management that has been observed is the adoption of a "contact person" system. This means that some engineers or project leaders are assigned as contact persons who account for communication and information sharing with the customer during the project. Usually these same persons are also responsible for a given customer relationship for a longer time. This means that they may contact long-time customers between projects in order to ask about the quality and functionality of the solutions designed in previous projects, and/or to discuss possible future projects.

Besides the "contact person" system, engineering consultancies often have their own workforce working on the site of the client firm, utilizing their facilities. This type of client interface helps to handle the whole knowledge cycle, i.e. knowledge creation, dissemination and interpretation, as well as the management of the organizational memory for learning. Simply said, the engineer's working on site helps taking into account the customer requirements and feedback quicker for developing better and possibly more innovative results.

Furthermore, the use ICT helps companies to operate in "virtual environments" to exchange drawings, designs and other information. For example, engineering consultancies typically establish project databases, from which clients can get access to project data and keep track of project progress. These kind of information sharing tools should result not only in shorter project lead times and cost reduction but also in general tightening of customer relationships [34].

4.3. Organizational innovations

Engineering firms often face the main challenge in innovation management, i.e. balancing between exploitation and exploration [see e.g. 39]. Practically, this can be seen in the new types of business and organizational models in which firms at the same time aim to continue their service providing with the present long-term customers in a traditional way, but also aim to participate in networks and collaboration relationships for new innovation-seeking businesses in the emerging markets, possibly with new clients. This requires recognition of the influencing factors related to collaboration in innovation, and development of intra- and inter-organizational routines for effective learning.

The transformation of knowledge-intensive engineering consultancies towards collaborative innovation can be seen as a phased process. The first phase, the recognition of a need for collaboration, is basically a step towards interest in the relationship development process and movement towards the implementation of collaboration. The implementation phase has similarities with the traditional arms-length market relationships, recognized for example in the automotive industries, where the primary purpose is to be efficient in the execution of routine tasks [40]. In the knowledge-intensive industries these routine tasks include, for example, the execution of standardized planning work and services. The final phase in the framework is collaborative innovation, where the primary purpose is to develop long-term interorganizational competitive advantage by routines that enable companies to dynamically create new services, processes, and products for the existing and new markets. The emphasis in these activities is therefore more on exploration than in the implementation phase. This implication is similar to the findings of Dyer and Singh [41], who suggest that relationships (alliances) generate competitive advantage only as they move the relationship away from the attributes of market relationships.

Generally, the increased outsourcing of engineering services [see e.g. 36] has influenced the development of different types of collaboration models for engineering consultancies. One possible model for engineering consultancies is to have a network with several specialized smaller firms and a bigger company as an "engine" of the network [e.g. 42]. The network engine is responsible for the whole service package, and the smaller firms have complementary competencies, which can be utilized for various purposes.

Normally, the route to collaborative innovation and technology development requires time, and starts first with the marketing collaboration and brand development moving then to technology development projects. If good results are received and trust exists between the companies, real collaborative innovation and finding access to both new markets and new technologies will be more realistic. For example, in the engineering consultancy network which has been established in South-East Finland, this type of phased development route has been conducted. However, in this case the "engine" and the main node of the network is a neutral third party. Increased outsourcing, internationalization and the fact that there exists one of the world's biggest hubs of pulp and paper industry in the South-East Finland have had an influence on the birth of this network. The network was officially started in 2004. In the first phase, the focus has been on market development, marketing and communications collaboration, and in the near future phases it will be more on technology development and collaborative innovation. There are 16 organizations in the network, which have signed the formal contract. This kind of network supports local collaborative projects, but with its help companies can also have access to new, innovative and large international projects.

4.4. Technological options

One important change in the engineering consulting sector has been the rapid pace of technology development. In particular, the use of CAD-programs has become ubiquitous in the engineering consultancy sector. This speeds up the design process and also diminishes the risks of human errors. Also, the application of three-dimensional (3D) modeling has enhanced the efficiency of producing drawings. Furthermore, engineering companies have developed or purchased specific software for process simulation, which is a central task in modeling. Then, in the forefront of the technological progress, there is fotogrammetry. This means that pictures from the production facilities are transmitted digitally to engineering companies for 3D modeling and documentation [36].

The use of ICT also integrates the information systems of engineering firms and their clients. This has facilitated the delivery of engineering services across long distances, and thus diminished the importance of geographic proximity. Since this also means that there is less need for foreign direct investment or sales conducted by local affiliates, services have become more tradable with foreign clients [35].

Finally, digitized data and advanced database management software have enabled engineering consultancies to offer completely new services. These include e.g. developing and hosting databases for documents concerning machinery upgrades and maintenance work in clients' manufacturing plants.

5. Conclusions

Service innovations are difficult to conceptualize. The traditional taxonomies of innovations have originally been developed for the purposes of analyzing innovations especially in the contexts of manufacturing innovations [24]. The special characteristics of services, e.g. intangibility, simultaneity, heterogeneity and perishability [2] bring forth differences between them and physical products, and therefore all the taxonomies of innovation cannot be straightforwardly applied for services.

As stated in previous studies [e.g. 14, 15], one of the most influential service sectors is the knowledge-intensive business services (KIBS). Wide ranges of KIBS sectors have been studied earlier [e.g. 32, 33]. There is, however, a need for service innovation studies focusing on particular KIBS sub-sectors, such as the technical engineering sector. In this paper we have analyzed the innovation patterns in Finnish engineering consultancies in terms of innovation types. The typologies have been adapted from den Hertog's [17] framework, including four dimensions of service innovation, i.e. service concepts, client interfaces, organizational innovations and technological options.

Recent trends in the engineering consultancy industry, i.e. increasing competition, industry consolidation, internationalization and increased use of ICT in engineering have forced firms to renew their business models and services. A need for increasing innovation activities exists, but at the same time industry characteristics, like project-oriented working patterns, as well as the polarized structure of the industry and traditional routines in firms set challenges to the renewal.

On the basis of our empirical qualitative analysis it can be concluded that for example innovation activities generally and transforming service into products and new service concepts are not actually very common in firms of this sector. Innovations, which in services are typically incremental by nature, often seem to occur in Finnish engineering KIBS as client-led innovations and innovations through services [cf. 17]. Typical examples of innovations in the studied sector are related to new organizational models and networks, which help working in a very close role with clients, or technology-based innovations which can finally take a form of new software. In many cases, the software is first developed to help internal activities, and if real customer needs have been noticed, then launched to the market.

The analysis above shows that all types or dimensions of service innovations can be recognized in the industry, and this adapted framework provides only one possibility to assess the activities, as all dimensions of innovations are difficult to be categorized to be examples of just one dimension. However, the original framework of den Hertog [17] also provides the view to interdependencies between different dimensions.

As a synthesis of the analysis we can carefully draw some preliminary conclusions about the general development needs in innovation patterns of engineering KIBS. First, we can assume that on the basis of the industry characteristics, and the need of increasing collaboration and networking in the industry, the companies should reassess their strategies and focus also on deeper collaborative innovation and other innovative organizational forms. This leads to a second recommendation, which is the development of exploration-related and innovation-oriented routines and working patterns in addition to the typical exploitation-related development. This observation is in line with e.g. Baark's [43] analysis of engineering consultancies in Hong Kong. Thirdly, it could be suggested that even though the customers in this industry have a relatively strong bargaining power and engineering firms are typically small in size, these small KIBS firms should also take care of their rights and clear game rules and contracts with regard to the innovations that could possibly be gained as a side-output of just normal project work with the clients. Also, developing a collaborative open innovation culture in the project business can increase work motivation and, in best cases, provide mutual benefits for all project partners.

A more thorough analysis of innovation patterns of this particular service sector in comparison with other service sectors in future studies could provide more generalizable results to be utilized in the policy- and decision-making of service innovation management. In future studies, wider datasets of service innovation patterns and KIBS firms could also help to analyze the antecedents of success, the service innovation process, as well as the results and their outcome, and, in particular, causal relationships and system dynamics of service innovations.

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