

# Modular service offerings in professional service firms – Variety of contexts and challenges

## *Competitive paper*

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## Abstract

Although professional services are most often highly customized services, modular service architectures can provide flexibility and cost-efficiency needed without influencing negatively firms' potential to be creative. The purpose of the present study is to examine, *how service modularity can be implemented within professional service firms (PSF)*.

Professional services are often generated from the expert-embedded, even tacit knowledge which is not easily shared among actors involved in the process. Implementing modularity may offer one way to facilitate knowledge sharing by enhancing processes of making tacit knowledge explicit and sharing it organisationally. However, we also acknowledge that nature of knowledge and related challenges of implementing modularity are connected to the specific PSF contexts. Thus, it is also necessary to define contextual differences there are in variety of professional service firms.

More specific research questions are defined as follows: 1) What are knowledge-related characteristics varying between different types of PSFs? 2) How those characteristics influence modularisation implementation in PSFs?

In the methodological analysis two company cases are analyzed to reveal how modularity can be implemented in varying PSF environments and what are related benefits and challenges of that implementation.

**Keywords:** knowledge sharing, tacit knowledge, knowledge codification, service modularity, loose coupling, process modularity

## INTRODUCTION

Like in many other areas of business, also professional service firms have faced ever increasing challenges of technological development, digitalisation of knowledge, global competition, cost pressures and acquisitions. Consequently, there is a salient need to intensify operations, increase flexibility, service quality and innovativeness - and to benefit from economies of scale (see e.g., Larsen 2001; Cameran, Moizer and Pettinicchio 2010). This leads to notable tension between standardisation and customisation in these organisations (Sundbo 1994).

Discussion of service modularity is one stream of research addressing these problems. Modularity has been extensively employed in the area of physical manufacturing (Ulrich 1995; Asan, Polat and Serdar 2004; McDermott, Mudambi and Parente 2013) and e.g. in computer science (Gil and Baldwin 2014). Recently it has been brought in to service context as well (Starr 2010) where it has been studied in variety of different service contexts (e.g. Jaakkola 2011; Lin, Pekkarinen and Ma 2015, Pekkarinen and Ulkuniemi 2008; Rahikka, Ulkuniemi and Pekkarinen 2011; Giannikis, Mee and Doran 2015)

Professional services represent a specific type of business service, one that is strongly based on the problem-solving skills and expertise of individuals working in the service provider firm (Løwendahl, Revang and Fosstenløykken 2001). Complexity and high level of customization are typical characteristics of professional services (Dawson 2000) and as a natural consequence of those characteristics, person-to-person level complex and intensive interaction and creativity in customer specific problem-solving situations represent key issues, ones that are difficult or even risky to manage (see e.g. Mitchell 1994; Løwendahl et al. 2001; Ojasalo 2001).

It has often been argued that expertise within professional services cannot be standardised or put in any predetermined format when generating offering to the customer. However, there are also views according to which standardising and concretising service offering would create many potential benefits for professional service firms (Starr 2010; McDermott et al. 2013), such as, e.g. more efficient and rational processes, accumulation of collective knowledge, help in selling situations and more time for expert work instead of routine tasks (Jaakkola 2011). As Lowendahl et al. (2001, 924) put it: *“Can we assume that for firms which deliver highly customized services, only the most costly form of coordination is applicable? Do the firms need to remain inefficient and costly to run, or can they develop modes of coordination and collaboration that reduce costs without reducing client responsiveness?”* Such standardization could possibly be achieved through modularisation – without sacrificing flexibility and customisation as prerequisites of creating services. Modularity has been argued to enable decomposition of knowledge into the components that makes it possible to split knowledge-intensive activities across business units in a flexible way (Araujo and Spring 2006). *“Even if the service product is individual, the processes and input elements could be standard, and vice versa”* (Sundbo 2002, 97). Thus, modular architectures can provide flexibility and adaptability needed in knowledge intensive service production in spite of service being based on highly customized service processes (Jaakkola 2011).

A typical challenge for professional service firms (PSF's) in relation to its service offering and customer relationship management is the internal incoherency in knowledge management practices, and that may cause incapability to coordinate knowledge resources needed in the

value co-creation (e.g. Kerkhoff et al. 2003; Nätti and Ojasalo 2008 a/b; Nätti and Still 2007). This is crucial, as innovative customer solutions most often created by combining different kinds of knowledge (see e.g. Cavusgil et al. 2003; Larsen 2001). Therefore, the applicability of modularity in addressing the challenge characteristic to professional service organisations deserves research attention. For example Spring (2003) suggests that there can be a coordinated approach to identify and modularize tacit knowledge to explicit to understand, evaluate and share knowledge in the organisation. Thus, modularity can potentially bring along many benefits in terms of knowledge sharing in characteristically fragmented PSFs.

The purpose of the present study is to find out, how service modularity can be employed within the context of professional services. Acknowledging the fact that the knowledge created in professional services is tightly embedded in the specific industry contexts, we aim to first define the contextual differences that can be identified in professional service firms, especially related to the nature of knowledge created through the services. The applicability of modularity is examined then based on these characteristics. The aim of the study is to develop a typology of different types of PSFs and description of factors influencing modularity in different PSF contexts.

Research questions:

- What are knowledge-related characteristics varying between different types of PSFs?
- How those characteristics influence modularisation implementation in varied PSFs?

We will first review the service modularity discussion to further define our research gap and to create a solid ground to the following discussion of professional services. When doing so we aim to identify the critical characteristics of the context in question in relation to service modularity - and the ones related to the knowledge sharing in particular. This theoretical pre-understanding is further elaborated through empirical case study of two professional service firms. Another one of the analyzed case firms provides training and consultancy services. Another provides engineering/construction management services. Data is composed of semi-structured interviews with service providers' personnel and customers.

The present study contributes to the existing theoretical discussion on service and process modularity by highlighting the specific context of professional service firms. Research of modularity in services is still scarce (Meyer and de Tore 1999 and 2000; Homann et al. 2004), despite of its potential for increasing flexibility and cost-efficiency in service production (see e.g. Fitzsimmons and Fitzsimmons 2004). This is especially true in the case of heterogenous and complex input and demand (Schilling 2000). There is only scarce knowledge of modularity and its implementation in professional service organisations (Pekkarinen and Ulkuniemi 2008; Spring 2003). The few there are (e.g. Jaakkola 2011) focus more on handling professional service organisations as a single entity, whereas we aim to recognize also contextual differences in these organisations, which has - according to many authors - been so far underestimated issue in PSF research (e.g., Von Nordenflycht 2010; Malhotra and Morris 2009; Robertson, Scarbrough and Swan 2003). In addition, by focusing more on defining underlying mechanisms influencing modularity efforts in these contexts, we are able to pay more attention to knowledge related aspects and variation in them.

The rest of this article is organized as follows. First, it discusses the theoretical aspects of modular service offering and processes (of designing, drafting, preparation/producing and completing) in professional service context. After explaining the methodology used in the present explorative case study, it introduces the analysis and findings of the study and also

suggests managerial guidelines for service modularity in this specific context. Finally, the article draws some final conclusions and offers avenues for further research.

## **MODULARITY AND PROFESSIONAL SERVICES**

The complexity of professional business service customization can be managed through modularization, where the service is seen as a bundle of “modules” that can be combined into various customized service offerings (Pekkarinen and Ulkuniemi 2008, see also Hyötyläinen and Möller 2007). Benefits of the use of modularity in developing business services can be described by two dimensions. First, degree of decomposition of the overall structure of a service, which is a set of benefits a service offers to a customer, put into defined functional elements constituting the explicit structure of the service. Second dimension is interface specifications defining how service modules will interact with each other together within the service (Sanchez and Collins 2001).

*Modular service platform/offering modularity* can include four dimensions to identify, develop and deliver services in a flexible and cost-efficient way: 1) Service, 2) process, 3) organizational and 4) customer interface dimensions (Pekkarinen and Ulkuniemi 2008). A service module is understood as a service element from which service projects are combined. It is the smallest unit into which services are divided. Thus, the customized professional service offering is a bundle of modules with knowledge content which can take a different form depending on the customer in questions and can still function as well independently (Pekkarinen and Ulkuniemi 2008).

*Process modularity* in service creation enable firms to solve problems faster and in a flexible manner. The process architecture specifies the decomposition of all the service and interaction processes into a set of activity components needed to make, distribute, and support a whole service process, and the specification of the interfaces between activity components that define how the activity components will interact (Sanchez 2004, see also Pil and Cohen 2006; Giannikis et al. 2015).

Knowledge intensive service production also necessitates some level of *organizational modularity* to enable the flexibility in combining knowledge and competences to variety of service offerings (See e.g. Sanchez and Mahoney 1996). In developing modular service offerings (modular innovations see e.g. Henderson and Clark, 1990; modular architecture see e.g. Voss and Hsuan 2009) the firms often have to do corresponding organizational rearrangements. This means that in order to benefit from modularity, also organizational structures and management system need to be often adapted towards more decentralized and network-like structures (Araujo 2006; Chesborough and Kusunoki 1999 in Nonaka and Teece 1999 as well as Brusoni and Prencipe 2001) to enable fluent combination of service modules and related expertise (e.g. Nätti and Ojasalo 2008). In addition to organizational factors, the customer interfaces, the encounter processes (Payne et al. 2008) and the boundaries between the customer and service provider (Araujo et al., 2003) need to be understood better from the viewpoint of modularity.

### **Nature of knowledge in PSFs**

Important factors related to organizational coordination are also the nature of operational explicit and tacit knowledge in use, knowledge transfer in intra- and inter-firm context and

communication capability of tacit knowledge (Spring 2003), which we aim to highlight in this piece of work. Nature of knowledge related to modularization efforts in PSFs plays an important role.

*“How do service firms after all manage to co-ordinate and coalesce the knowledge that exists within the organisation in order that the whole becomes greater than the sum of the parts?” (Larsen 2001, 100)*

A classic definition of professional service firms suggests them being characterized by knowledge intensity, low capital intensity and professionalized work force (Von Nordenflycht 2010). Thus, capability to coordinate internal and external knowledge assets is critical for these organisations (Greenwood, Li, Prakash and Deephouse 2005), especially an ability to accumulate firm’s collective knowledge base and knowing how to make tacit knowledge explicit (Lara, Palacios-Marques and Devece 2012) – to the extent it is possible.

A high level of customization, complex nature of expertise, expert-embeddedness, and a high level of interaction needed with the customers are all suggested to be characteristic of knowledge intensive professional services (Løwendahl 1997). Indeed, as professional business services are often detailed and complicated, they require more interaction with the customer to ensure adequate knowledge sharing in creating the service offering (see e.g. Fosstenlokken, Løwendahl and Revang 2003; Halinen 1997; Dawson 2000). In knowledge-intensive services the human touch-points with the customer are inevitable and there is a need for special attention to coordinate knowledge sharing (Ojasalo 2001; Mitchell 1994).

While knowledge is often very expert-embedded, modularity may offer one possibility to facilitate knowledge sharing by enhancing processes of making tacit knowledge explicit – and more understandable for customer. However, it is important to notice that although modularisation brings front a strong emphasis on explicit aspects of knowledge, tacit knowledge is always a prevalent part of service encounters in this specific context considering prevalent complexity and unique nature of professional work. (Giannikis et al. 2015; Rahikka et al. 2011)

As mentioned, efficient internal processes for sharing and making use of the knowledge in the professional service context are needed (Campbell 2003) to enable modularity development. However, in general professional service organizations are not very successful in managing their knowledge resources (e.g. Kerkhoff et al. 2003). The loose coupling characteristic to professional service firms (Nätti and Ojasalo 2008 a/b) and high preference for autonomy and even aversion towards direction and formal management system (e.g. Starbuck 1992; Von Nordenflycht 2010) might lead to the internal incoherence of knowledge coordination practices and following incapability to integrate and utilise all the knowledge resources needed in the value creation process with the customer (e.g. Payne et al. 2008). Much of the knowledge needed stays in the minds of single employees (Nätti and Still 2007), also because of its tacit nature. Although there might be a very high level of external knowledge exploration and individual learning, knowledge is not fully exploited at the organizational level (March 1991; see also Jensen et al. 2010). *“To managers only parts of the knowledge and qualifications of staff are visible, as they are documented in track records and diplomas. Such instruments do not reflect how knowledge production takes place, how knowledge changes dynamically, or even what knowledge the organization currently possesses”* (Larsen 2001, 82). From the customer point of view, kind of challenges may lead to the fragmented and incomplete service experience (Nätti and Ojasalo 2008a).

Challenges in transferring and sharing knowledge in professional service organization depend on the nature of knowledge (Chen 2005) and organization in question (Nätti and Ojasalo 2008). Menor et al. (2002) highlight that the professional service firms have to deploy knowledge both by exploiting, e.g. codifying and transferring of existing knowledge, and by exploring methods, practices and tools to search and develop new knowledge. For example, from service production point of view it is crucial to possess organizational knowledge of who knows what (see e.g. Argote 1999; Larsen 2001) in the professional firm. In addition, codified knowledge and common understanding of internal processes to create service offerings are needed (Jaakkola 2011) to mobilise appropriate qualifications from the distributed knowledge system (Larsen 2001). In these modularity can help (see Giannikis et al. 2015).

Thus, in the following characteristics relevant relative to knowledge sharing in PSF are reviewed. In the methodology this review is used as basis to argue the choice of the two cases of the study by defining differences between them. In the methodological analysis explorative cases reveal how modularity can be utilized in two different PSF environments. In the conclusions, theoretical views are drawn based on the contextual characteristics and empirical study. In other words, how modularity can be used in PSF and what contextual differences in PSF's influence usage of modularity.

### **Various knowledge bases of PSFs**

There are many issues influencing development of modular service offerings in PSFs. Although there seems to be prevalent common challenges in PSFs in relation to knowledge sharing, it would be too much of a simplification to suggest that they are all alike. The starting point is them being knowledge-intensive, but actually those organisations vary a lot in the degree of intensity of tacit knowledge (see e.g., Von Nordenflycht 2010) and in many other characteristics as described in the following. Consequently, we have to define modularity enablers and challenges in relation to those specific organizational characteristics, not handling PSF as one general type of an organization. In the following, we have chosen issues we suggest are meaningful as a basis for analysis from the modularity viewpoint.

*Nature of knowledge* is one of core issues distinguishing PSFs from each other; companies differ in terms of their knowledge bases (e.g., Malhotra and Morris 2009). This is also a very prevalent factor in relation to modularity and how “this translates into differences in the organization of professional firms” (Malhotra and Morris 2009, 902).

*“Instead of searching for a single dichotomous definition of a PSF, we might make more progress by thinking of degrees of professional service intensity, based on the presence of more or fewer of the characteristics”* (Von Nordenflycht 2010, 165).

There are variety of “epistemological bases of professions” (Robertson et al. 2003). For example, Malhotra and Morris (2009, 904-905) distinguish normative, syncretic and technical knowledge and its relative influence on organisational form in PSF. According to authors, normative knowledge base “*is compatible with low levels of hierarchy, high levels of task autonomy, high decentralisation of authority and high consensus in decision making, resulting in a predominantly professional form of organisation*”. On the other hand they define syncretic knowledge base being “*a hybrid of a professional form and a bureaucratic form. Engineering has a predominantly technical knowledge base. Its application in*

*engineering consulting firms is likely to be supported by the highest levels of hierarchy, relatively less task autonomy, and a balance between centralization (firm level) and decentralization (project level), resulting in a more bureaucratic form*". Thus, theoretically there is suggested to be an important distinction between PSFs in ways that knowledge is created in the first hand among professionals, and institutionalised to the collective knowledge pool of the organisation on the other (Robertson et al. 2003).

This leads us to look at how we can categorize differences in PSF's knowledge base. In addition to the mentioned *tacit vs. explicit aspect* of knowledge, also other dimensions can be defined referring to the characteristics of knowledge: *observable in use – not observable, complex – simple, and element in a system – independent* (Winter 1987). These distinctions are particularly valuable when the knowledge sharing in a knowledge intensive organization is the focus of analysis. They are directly related to the ease of knowledge sharing, or its "stickiness" (e.g. Szulanski 1996). In general related to PSFs it is suggested that knowledge *is more often not observable than observable, more often complex than simple, and often embedded in people conducting services* (see e.g., Starbuck 1992; Boisot 1998). However, we suggest that the intensity of these factors may vary in different PSF contexts. For example, in technical environment knowledge is characteristicly more observable and "objective", i.e. not so embedded to single experts only, whereas there are professional services relying to a large extent on tacit, highly embedded and hard-to-observe knowledge.

Robertson and al. (2003, 835-836) have reviewed the literature to reveal the organizational features that influence knowledge creation in PSF. From our viewpoint important and interesting themes were – for example - the meaning of *degree of work autonomy* of professionals, and the influence of *social identity*; "*Workers categorization of self (in relation to others) and in their role expectations and behaviours*" (Robertson and al. 2003, 836, see also Alvesson 2001). For example, the strong identity of a single expert group can hamper knowledge transfer between the actors and groups in PSF (e.g. Nätti and Ojasalo 2008) because of the unwillingness to share knowledge outside one's reference group, or plain difficulty to "find common language" with those outside one's own group.

In general, it is suggested that it may be hard for professionals to understand the significance of institutionalizing and codifying knowledge for purposes of the whole organization: "*what is rational at the collective level (contributing to the shared knowledge) may not be rational at the individual level (protecting individual expertise, or earning more money by moving on immediately to the next project and new "billable hours" – and to share the knowledge in its tacit form*" (Løwendahl et al. 2001, 921). "... *The closer to the termination of a project, when experiences really should be gained and reported in databases, the less incentive there is to do the bureaucratic job*" (Larsen 2001, 98). However, this can also vary in different PSF contexts.

In some PSF's, firm-specific and *unique knowledge* is used whereas others rely more on *general knowledge* and skills offering more flexibility to activities. For example, in management consulting firms experts often focus on developing their own knowledge base and approaches whereas in engineering the emphasis is on general technical knowledge offering more possibilities for cooperation with colleagues too. (Løwendahl and al 2001)

Is the *degree of service customization* high or low determines the type of interaction needed in the customer relationships (Løwendahl et al. 2001). In PSF the prevalent challenge lies in trying to be efficient, flexible and creative at the same time. Applying modularity teases this

tension out even more. PSFs vary in terms of their services and how easily those services can be predefined. As Lowendahl et al. (2001, 924) well states the core issue of uniqueness vs. generality: “*If tasks can be subdivided and coordinated by standardisation, maybe combined with plans and milestones, coordination costs can be relatively moderate. However, when tasks require substantial customisation and interaction with the client, may be even in innovative teams with simultaneous presence, tasks cannot be preplanned and the costs of mutual adjustment are unavoidable*”. This further highlights one important difference: What is the meaning of process itself, what is the meaning of outcome and where the emphasis lies? For example, in steering group consulting the process itself is core of the service, whereas in the creation of architect the end result is more under evaluation – also because it is more concrete. Also, level of *regulation of activities* varies in different service areas, likewise regulation and control over knowledge used. For example, you do not necessarily need permission to act as a consultant of whatever (it is totally up to your customer to evaluate the value you have to offer) but you cannot practice law or medicine without proper qualifications.

**Insert figure 1 here**

### **Distinctive factors related to management system among PSFs**

In relation to knowledge sharing and modularity, characteristics of management system of PSF are worth examining when trying to implement the idea of modularity in this specific context. “Traditional aspects” of management like directions and rewards, reporting, planning and coordination systems are without a doubt influential. However, in PSF it is also very prevalent to pay a close attention to *communities of practice and social interaction* – and how professionals in general interpret managerial efforts (Larsen 2001; Løwendahl et al. 2001; Nätti and Ojasalo 2008 a/b)

One natural characteristic influencing knowledge sharing in PSFs is *the level of diversification*. Diversification in PSF sector has been a strong trend lately: PSFs no longer focus on one expertise area only, but diversify their activities to close fields of business. Consider for example former book-keeping firms. Those companies nowadays focus on creating holistic services for financial administration and management for their customers. Consider advertising agencies: they are nowadays offering holistic solutions for company and product brand development (see e.g., Greenwood et al. 2005; Nachum 1996). Scope of PSF activities have widened out and consequently challenges for service development externally have increased in many PSFs. The level of diversification has brought up the benefits of developing modularity in service offering to tackle complexity of diversified needs, and this is relevant for every type of PSFs.

Likewise, and along above mentioned diversification process, *decentralisation of authority and activities* has been a natural consequence of a need for deeper understanding of customer characteristics and local attributes: “*The local orientation of most professional service industries and the need for deep knowledge of the clients require decentralisation of authority and a large amount of independence for the subsidiaries*” (Nachum 1996, 483).

It is often claimed that in PSF firms cannot form too tight structures and/or coordination without sacrificing creativity and flexibility needed in professional work (see e.g. Nachum 1996). Indeed, there seems to be a constant tension between need for *flexibility and autonomy for experts* and on the other hand the need for organisational coordination to benefit from

lessons learned (Nätti and Ojasalo 2008b), which is definitely needed also in the modularisation practices. However, also at this point PSFs vary considerably. Indeed, some PSFs – at least to a certain extent – “produce” quite standardised services, following certain regulated procedures (consider e.g., book keeping, basic, standardised technical planning etc.) whereas other services are always highly customised and “creativity is the most essential component of the production” (e.g., steering group process consulting, advertising agencies). (Nachum 1996, 478.) For its part, modularity efforts may even increase this tension further emphasising the aspect of *organisation-level coordination*; there is an evident contradiction to give freedom for professionals and space for creativeness. On the other hand there is a strong pressure to enhance competitiveness by coordinating and controlling activities more tightly (Larsen 2001, 98) and the kind of coordination is needed also related to modularity.

Challenges to form strong social identity (see e.g., Robertson et al. 2003) for one’s profession can be bigger in more ambiguous, normative environments while identity is stronger going towards technical and regulated professions. For example, for business consultant the identity might be harder to build up and comprehend because of more ambiguous nature of the expertise area and related knowledge needed, whereas for us all it is easier to understand what lawyer, dentist or civil engineer does, i.e. in those level of workforce professionalization is higher (e.g., Von Nordenflycht, 2010). The challenge to build up social identity or professionalism might be related to difficulties in developing service modules, for defining expertise as a basic component of service module is harder when social identity is weaker.

**Insert figure 2 here**

## METHODOLOGY

The theoretical pre-understanding presented above will be elaborated through a study of two cases representing different kind of professional service firms. The first one is more towards normative type of organization whereas the other one represents technical organization type (Malhotra and Morris 2009). A case-study strategy was selected because it enables forming a comprehensive view of a context-specific situation (Yin, 2003), and also offers new insights into a phenomenon of which little is known (Eisenhardt, 1989). The study is an exploratory in nature (Yin, 2003) as we set out to explore the possible ways of using modularity considering variety of characteristics in PSF context. In choosing the case study strategy and selecting the cases, we took as a starting point the nature of the services under scrutiny. In studying knowledge-intensive business services, we wanted to take into account the different types of services and service organisations to widen out the understanding of the phenomenon in this specific context and avoid trap of handling PSF as one and unanimous organization “type”. Therefore, we aimed to identify two information-rich cases that would enable us to explore, how service modularity could be applied to these contexts.

Based on our theoretical pre-understanding, we aimed to find two cases that would represent the two opposite ends of the identified characteristics of PSFs. Acknowledging the difficulty of identifying cases that would indisputably fit into all of the characteristics, we specifically looked for services that would demonstrate differences in level of regulation in the business which is a reasonably easily observable characteristic. To identify a case representing the low level of regulation, we chose the business consulting area, in which the innovation based on deep contextual knowledge typically plays a crucial knowledge. Thus the first case organization represents a PSF firm providing consulting and training services in management, leadership and technology (normative). As a case representing high regulation environment,

we took the engineering services; construction represents an industry which is highly regulated through instructions, norms, standards and inspections conducted by authorities. The second case is thus a provider of engineering, procurement and construction management services to manufacturing companies in forestry, metal and chemical industries and also to actors in public sector and commercial construction (technical).

These firms were selected for comparison for several reasons: Both companies offer demanding professional services for their clients and in those processes they apply and create new knowledge on a continual basis (for similar setting, see e.g., Robertson and al. 2003). However, these companies vary in many respects: nature of knowledge and professionalism in question, degree of customisation, role of innovation and creativity. Naturally, completely “ideal” types are impossible to find, however, according to our view these cases for a solid ground to our further analysis.

*Educator.* The first case company is an institute *offering training and consultancy services in the area of management and technology*. It employs 60 people and is structured in three subunits based on area of expertise. During the research period every unit had its own professionals, who had similar educational and employment backgrounds. This company was entering into a partnership-agreement-based relationship with two technological service organization willing to outsource its personnel development functions. This relationship provided an interesting setting to investigate the challenges of service modularity in this type of PSF. Changing emphasis towards strategic partnerships as a way to handle customer relationships can be assumed to require access to a wider range of internal knowledge resources which brings up the criticality of service modularity. Altogether 12 interviews were made in this case including eight interviews of company representatives and four customer interviews.

*Engineering.* The company operates worldwide and has operations in 45 countries and personnel of about 8,000 people. The company’s turnover in 2006 was some 650 million euros and its three main business areas each represent about one third of the turnover. The company’s business consists of project assignments covering the entire lifecycle of their customers’ investment projects. The company provides both management consulting services and technical professional services, however, our focus is on technology side compared to Educator case. The case company’s customers from small local to large global actors in the private or commercial sector turn to the company when in need of construction planning, engineering, implementation and start-up services. This case is based on 9 interviews of the representatives of the company and four customer interviews.

### **Data collection**

Data were mainly collected through semi-structured interviews with service provider personnel as well as managers from two customer companies. Different types of documents, e.g., internal memos, customer magazines, company web sites, product brochures and a specific service product model software presentation were also proved as important sources of evidence and helped in triangulating interview accounts (Yin, 2003).

Both representatives of PSF’s and customer companies were interviewed in Educator and Engineering cases, however, in IT-consulting case customer interviews are lacking (see Table 1). The interviews covered, quite broadly, issues around the customer-service provider

relationships, project cycles and service processes. The interviews were recorded and transcribed.

Case	Status of the interviewee	
Educator	Key account manager	
	Key account assistant	
	Member 1 of the steering group	
	Member 2 of the steering group	
	Member 3 of the steering group	
	Consultant 1	
	Consultant 2	
	Consultant 3	
	Customer 1 (1 <sup>st</sup> customer company)	
	Customer 2 (1 <sup>st</sup> customer company)	
	Customer 3 (2 <sup>nd</sup> customer company)	
	Customer 4 (2 <sup>nd</sup> customer company)	
	Engineering	Quality Manager
		Department Manager
District Manager		
Office Manager		
Vice President, Project Management		
Project Manager		
Engineer		
Chief Engineer 1		
Chief Engineer2		
Customer: Factory Service Manager		
Customer: Automation Specialist		
Customer: Large Industry Project's Owner's representative		
Customer: Production Manager		

## EMPIRICAL ANALYSIS

In the following, we will discuss the two cases in the light of our theoretical pre-understanding and divided into knowledge base (characteristics of knowledge) and modularity implications (offering, process and organization).

### Analysis of modularity in Educator

#### Knowledge base

In this organisation, in the beginning of the research period, there were no tools in active use for managing internal knowledge on competences possessed by experts or customer-related knowledge either. *The IT -system was recently established*, however, experts to a large extent ignored its usage. Utilisation of such a system caused challenges because of lacking common procedures and rules to use it. Services were based to a large extent to *quite unique and also ambiguous knowledge* that was *embedded to individual experts*. That kind of knowledge is not easily observable, but more tacit by nature. Such a knowledge has *high level of "stickiness"*, it is not easily transferred.

“We have no “catalogue” where one could see what type of things people do.” (Manager, Educator)

In this case organisation stickiness was also related to the nature of customer relationships: Many customer relationships were strongly “owned” by certain professionals or small teams of professionals, leading to challenges of sharing customer-related knowledge too. This ownership was a natural consequence of the tacit nature of knowledge used in services: Relationships and trust between professionals and their customers were developed based on common experiences in various projects, thus, customers also relied on professionals they know because for them it is harder to evaluate service per se. If the service is based to a large extent on professional-embedded tacit knowledge, as in this case, also high level of customer participation, control, interaction and influence becomes part of the service delivery. Process itself becomes important, not the end result or influence of it only (which is, in addition, very hard to measure often times). Kind of consulting and training services are not under regulation or control of any official party, in other words, there is higher level of freedom in realizing services.

In addition, in this case strong individualistic culture, “expertsilos” and competition between professionals and teams hampered knowledge sharing at all levels and in its all forms: both expertise-related and customer-related knowledge. Consequently, knowledge stayed embedded to individuals and separate teams and this harmed modularisation efforts.

*Also because of its tacit nature, knowledge was not accumulating from earlier projects to the extent it would have been possible, and in this sense also value aspects and project impacts stayed quite abstract both to the experts and customers. This hampered modularisation efforts and led to the situation where every single customer project was to a large extent tailored from scratch.*

“What we are lacking completely is service conceptualisation. We have conceptualised in a way that [the service] “belongs” to someone, and that someone always customises them customer-specifically”. (Educator, Manager)

Indeed, in this kind of normative PSFs it is often one part of *social identity of professionals* that they are more loyal to him/herself than to his/her organisation, and this brings along tension between gains in individual knowledge versus gains in collective knowledge, which may further make modularization efforts challenging. Compensating this “natural instinct” is closely related to the management practices of the organization. For example, in Educator case the management system could not provide sufficient incentives for knowledge codification to IT systems of sharing it in cooperation. For example, kind of activity was not “measured” or followed by any means.

As we can see from the previous analysis, in this kind of professional context there may be a tendency towards “expert orientation” instead of collective, organization or customer-orientation; Expert him/herself and/or developing one’s expertise may be strongly emphasized as the starting point, not the customer need. This is a challenge for modularization efforts.

“In the organisation there are also these “instincts”, meaning that people’s own interests also drive the organisation in their respective directions. And those directions are not necessarily the same directions that are needed in customer-oriented operations”. (Educator, Manager)

Coming back to incentives for professionals, motivating people to use common IT systems as basis for service modularity can be challenging because it is not always easy to see how the knowledge is used later or how an individual professional can benefit from the knowledge shared/stored. Thus, retrieving the knowledge shared in the new work context as soon as

possible seems to increase the motivation for sharing activities. If the benefits are not recognized soon enough, or even at all, motivation to share knowledge will decrease.

“It feels like people cannot see the final meaning [of using the common system], so it does not motivate them to use the system either.” (Educator, Consultant)

High level of confidentiality in customer relationships characteristic to consulting business might also influence the willingness to share and codify knowledge, and it is also one aspect of social identity experts maintain: Because of close and established customer relationships, they want to *stay loyal to their customers* and want to keep customer knowledge to themselves to ensure that there are no information leaks.

Thus, in terms of modularity in the offering, because of the earlier mentioned problems in internal knowledge sharing, the decomposition and integration of the service modules was problematic in the first place. *Lacking knowledge codification and knowledge sharing* did not support breaking up the service processes into smaller parts, which can then be integrated to form a specific service.

The kind of problems in modularity may have many reflections in the customer relationships. The *scope of the relationship may remain narrow*, meaning that when there is no sufficient level of modularity, only limited scope of expertise is utilised in service offerings further the innovativeness and novelty of the offering.

“... How innovative Educator is to bring new ideas, solutions - it is lacking... One would expect more innovativeness and initiativeness.” (Educator, Customer)

Indeed, a typical challenge related to service development in this kind of professional context is the problem of specifying the service, both in seller and buyer side (see e.g., Ojasalo, 2001) Looking from professional point of view (and also considering above mentioned aspects), when service codification is lacking, it may not be understood what kind of expertise other professionals have to offer to the customer - in addition to potentially lacking willingness to sell that expertise.

“... So the people could speak to the customer also about the services of other teams. In practice, there is an extremely strong barrier between those teams. That kind of thinking is something we have to get rid of somehow.” (Educator, Manager)

### **Modularity Implications**

In terms of *offering modularity*, the organization's offerings included both *highly tailored solutions* to individual customer organizations but also more standardized services were offered, e.g. education that was provided to individuals from several different customer organizations. However, in developing tailored service offerings to organizations, high level of expertise were needed to compile the whole solution and the mechanism for knowledge transfer between the individuals and organization were crucial. Thus, in terms of service production of the tailored solutions, the case company's service offering demonstrated rather low level of modularity.

*Process modularity* can be seen as the service process steps that need to be performed in order to produce a service module. The organization did not have clear process description for its key service processes, but rather they worked on a more project based form developing unique services with processes that emerged ad hoc. This was connected to the problems in a ways of working and documenting the projects, expertise and customer-related knowledge,

*knowledge was not accumulated to the organisational knowledge pool to the extent that it would have sufficiently enough supported process modularity. To some extent, administrative processes related to projects were standardised which represented some level of process modularity in a service production process. However - at the level of combining expertise to the holistic offering based on customer value creation needs - efforts were more or less unique and based on local practices of different teams and organisational functions.*

*Organization modularity refers to the flexible allocation of company personnel or external third-party service provider's personnel. The case organization has a functional structure which is based on different areas of expertise. Thus, there are teams forming strong subunits focusing on conducting development services in the areas of leadership, human resource management, technology and production-related issues. Every team has its own experts and leader. Members in these groups share quite similar type of expertise and professional background which makes groups very coherent based on their own professional identity, and to some extent also isolated from other groups. Knowledge sharing between these groups is problematic because of competitive attitudes and different professional cultures (including difficulty to find "common language" to discuss issues). Thus, the strong expert-based teams based on functional areas did provide flexible means to organize teams according to each service within the functional area, whereas teams around service offerings combining expertise across the functional areas were more difficult to organize, due to low level of organizational modularity across the functional areas. Concentration of expertise on strong professional teams hindered the organizational modularity.*

Considering organizational modularity and related internal knowledge sharing, it is important to notice the prominent role of *metrics* by which individual and group level result is evaluated. The way measurement is done strongly influences knowledge sharing, especially if it forces competition and knowledge protection among the experts and expert groups.

"It emerges exactly from this that certainly if the result was measured individually, everyone would take care of their own area. When the result is measured team-based, everyone takes care of their own team. These silos are strong, everyone is optimising their own activities." (Educator, Manager)

"... That we could learn to utilise better different types of expertise to benefit the customers, but change initiates from people's attitudes, and apparent or structural change does not yet change things. Or then result measurements have to steer things very strongly." (Educator, Consultant)

Also in Educator the need to develop organizational structure was recognized. Instead of the former expertise/functional-based structure, there was a plan to develop processual matrix structure combining different professional teams to each other more tightly. The aim of this change was to produce more innovative service concepts and guarantee a wider usage of organisational resources in a more flexible way.

One valuable aspect of the new structure was seen to be a prerequisite for a more objective evaluation of the cost-effectiveness of different concepts. According to the plan, service concepts and experts are "separated", and evaluation is thus differentiated from the "possessive, individualistic attitudes" or the protection of the expert's own service concepts.

"It is good in principle, basically there are all the necessary elements for a functioning model. It is only dependent upon how well they can emphasise that there are varied expertise areas which are really responsible for their product conceptualisation, and then understanding the selling and marketing channels [different service types] which are a way to bring those services to the customer." (Educator, Manager)

It is apparent that this company *has not been capable of creating and utilising wider network of external experts or service providers based on the fact that combining expertise even internally is considered very challenging*. This is also related to the fact that single experts' own personal networks are not necessarily shared organisationally, or via IT-system. Thus, those networks are not a possession of an organisation, but possessed by single experts only.

### **Analysis of modularity in Engineering**

#### **Knowledge base**

*Engineering* has developed a service product model (SPM) based on the company's best practices, which enabled the knowledge accumulation and even its effective use. The model was designed to *combine the vast experience* created within the company during decades of experience on providing engineering and consulting services to different industries. Previously the professional services were heavily based on individual experts experience and personal level relationships generated in previous customer projects. This was considered as a strength but also a threat in the sense that the role of individual expert's knowledge was so high. Also, as the company grows larger, it was considered as a huge challenge, that the knowledge was scattered across the company and identifying the best experts to each customer project was difficult.

The model was based on managing large infrastructure construction projects and included various dimensions related to construction project management. The aim was to create an interactive and customer-oriented *generic service project management model modifiable to different customer needs* and applicable to multinational and –cultural projects. Thus, with the SPM the case company's *value provision is generated from its professionalism related to service projects as well as its capabilities accumulated from previous projects*. The SPM enables the *visibility and transparency* of elements included in the service project easing the customer's buying process.

”[With the model] we can achieve visibility. We can communicate to the customer that we want to be in the same boat with them in terms of managing their infrastructure project.” Vice-President, Project Management

This system is beneficial in many ways. It enables *combining heterogenous competencies to the holistic service offering* and provides a tool for managing human resources by enhancing communicating the customer promise. It justifies pricing decisions according to required resources. In addition, the SPM enables a *clear definition of the responsibilities* of the parties involved. Basically, the model means that all the processes are carefully depicted in terms of what are included and who is responsible for each area and task. As a result of this model, the software in question produces different documents automatically.

The person centered way of ensuring the needed knowledge flow between the service provider and the customer company is of course potentially very risky for the both parties in case of personnel changes for example. In order to avoid these risks, the service provider tries to increase the use of the SPM software. However, the adoption of the model has faced also difficulties. In terms of the SPM model and the actual content of the software, it would be essential that the experts of the company working in customer projects use the model and contribute also the content of the software, In this understanding of the meaning of codification and finding motivation to do that has been challenging to many professionals, likewise in case Educator, although prerequisites for knowledge sharing are better.

## **Modularity Implications**

In terms of *modularity in the offering*, the SPM was based on the modularity idea altogether. Through it, the decomposition and integration of the service modules were made possible. In the model the functions, processes and tasks represent a certain type of modularity as they *break up the service processes into smaller parts which can then be integrated to form a specific, tailored service offering*. In other words, the expertise of professionals is realized in independent parts, *into functions, processes, tasks and deliverables which are more easily combined to holistic service offerings*.

Considering the process modularity, the role of clear process-like descriptions in the whole industry context was distinctive. Construction includes various different *clearly defined process steps and procedures that need to be followed*. Most of the processes are also regulated by the law and other similar-like instructions provided by different authorities. Engineering is heavily process-based activity. Therefore, the level of process-based conceptualizations of the services provided by Engineering was very high. These processes were also used as service modules that were used to compose the tailored solution for each customer. The process descriptions also *enabled the knowledge transfer and standardization of the service processes*.

At Engineering *the modularity in organization* become apparent in their organization structure and their large network of service sub-suppliers. Due to the acquisitions of smaller engineering firms *Engineering is structured in a de-centralized manner which allows quite independent operation in the affiliates and branch offices*. They have only four main offices globally but altogether there are hundreds of offices in 47 countries. This way Engineering can provide globally wide network of offices that can provide localized service while giving them support from the head quarters level at the same time. The large modular organization enables the development of competence simultaneously with the daily operations. Instead of the big mother organization, the small offices are perceived more approachable by the customers and they also appreciate Engineering's experience on the local conditions, e.g. language skills and knowledge on the weather conditions. Hence, it can be seen that with local offices a company can ensure flexibility in the organization that is also detected by the customers.

Although there are many units in question, this company has found its ways to coordinate the system and has created mechanisms for knowledge sharing between the units. This way they can provide a globally wide network of offices that can provide localized service while giving them support from the headquarters level at the same time. Knowledge sharing between the units and experts located all around the world was seen as essential.

“..There's one offering process going on in Denmark this week which I think is a good example of this flexibility. We have a small office there at that locality in Denmark that is used to doing thing with the customer but this time the project is so large that they don't have the resources. And the customer doesn't believe that the small office could handle it either. So we have cooperation between our Danish office and Finnish office. --- We maximize the things we can do there and then take some typical process managers or leaders from here. In a way we agree that that the project's responsibility is in here because it is so big. --- by offering this combination we believe that we have a better shot at getting the job. If we'd offer only from Finland I don't think it would be enough. And if we'd offer just from Denmark it wouldn't be enough.“ (Engineering, Vice President in Project Management)

In Engineering case, the organization of the company includes several internal companies, so the case company supplies some modules and tasks from other internal partners, and also offers modules to them. Project customer-specific teams with multi-skills members are organized after a decision by the customer about the service agreement/project has been made. Also, external parties are involved in the supply network of the case company, e.g., architects' services. Knowledge codification/service modularity internally and in collaborative organizations makes this possible.

### Synthesis of the cases

It is important to notice, that compared to Educator case *prerequisites of Engineering from the modularity point of view are totally different*. One of the enabling factors in modularity efforts is the concrete nature of the construction expertise and its different engineering areas: HPAC (heating, plumbing, air conditioning), electricity, automation, plumbing, process, plant and structure engineering etc. Knowledge base related to these service areas (and compared to earlier Educator case) is more explicit by nature, thus, it is easier to build up a common organisational knowledge pool from it. Because of its explicit nature, it is not so much embedded to certain individuals, but is more based on certain generic professional knowledge base, common to every professional expert in the certain area (for example, if you are an expert in plant construction, your knowledge base and professional identity is more easily defined than if you are an expert in the area of steering group process consulting).

Technical knowledge is more observable, concrete and not so “sticky” but more easily transferred from worker to another, also because “common language” between workers is easier to attain. In this situation service development and delivery can rely (compared to normative environment) more to professionals than to customers, however, customer interaction and participation in service process is naturally needed too because services delivered are often complex, tailored entities anyway, although those are based on clearly defined technical modules. Indeed, related to customer relationships, the same phenomenon was observed like in Educator case. The need to extensive knowledge sharing often resulted in *emphasising personal relationships within the business relationships*. In complex customer projects, the customers often preferred to use the same service providers and specific experts in them to ease the problem of knowledge sharing..

"Instead of going through extensive negotiations, we prefer just to call them [the service provider] and ask them to send a certain guy here. We will show him what he needs to do. It takes just an hour because he knows our systems so well" (Engineering, Customer, Factory Service Manager)

However, we suggest that compared to Educator case, focus is more on *outcome than in process itself*. Likewise, there are lots of *regulations* involved (related to construction regulations, for example) which further facilitates modularisation by decreasing possibilities of knowledge implementation.

It is interesting to observe that problems in this kind of professional environment might be totally opposite than in case Educator where abstract knowledge base and consequent lacking codification was the challenge. Especially in the kind of technical environment the codification might be quite natural part of the job, *but there might be a danger of ignoring the related tacit aspects of knowledge* which may further cause misunderstandings in tailoring offering to the customer. This was recognized in the Engineering:

“When copy-pasting the texts from old project plans to new project plans, there is always the risk that we have no clue whether there was a certain reason to do something in a specific way in the old projects. The reasons were not usually written in the project documents. Thus, this kind of copy-pasting of old texts could make things seriously wrong.” (Engineering, Vice President in Project Management)

*Modular processes* can be seen as the invisible service process steps that need to be performed in order to produce a service module. These kinds of standardized processes clearly exist in Engineering’s ways of working and documenting the progress of projects, based on the *best practice knowledge* that has accumulated throughout the years in the organization. With the modular processes Engineering can ensure the quality of their engineering designs and improve the compatibility and flexibility of different service modules. *The company utilizes the modular processes not only in individual projects but also between their business lines.* In addition to this, the different types of building regulations and other regulation related to construction business give certain amount of structure to the service processes, and these can also be considered to create modularity into the services.

**Insert figure 3 here**

## CONCLUSIONS

The present paper set out to find out, how service modularity can be employed within the context of professional services. Our aim has been to contribute to the discussion of the challenges and coordination mechanisms related to modular service offerings in knowledge-intensive service organizations. Especially, we have focused on finding differences in varied professional service firm contexts and knowledge bases, and to examine how those differences influence modularization efforts in knowledge intensive contexts.

When comparing the two cases, one of the key observation that the capability to codify and share the codified knowledge at the organisational level can be facilitated through modularity. On the other hand, limitations in knowledge codification and sharing can hinder the deployment of modularity, especially in terms of offering modularity. Experts holding back their knowledge can limit the identification and re-combining of modules making up the offering. This is well-acknowledged challenge in knowledge intensive context: knowledge being embedded to individual professionals instead of common organisational knowledge pool. These problems have been argued to be prevalent especially within the type of PSF where knowledge base is more tacit, ambiguous, non-observable and relative “stickiness” of knowledge is quite high (e.g., Winter 1987; Szulanski 1996; Malhotra and Morris, 2009). More importantly, our data gave indication that organizational modularity may be employed to subtract this. Creating organizational structures that enable the flexible combining of experts into meaningful project based organizations can result in more extensive knowledge sharing; not only in specific functional areas of silos but on a more wider basis. However, it seems that organizational modularity requires some level of process modularity to fully operate; otherwise the high level of uniqueness remains and standardization remains low. Thus, the uniqueness of projects and interest in standardizing and copying parts of projects can be considered as an internal knowledge sharing problem.

We also observed that knowledge sharing and modularization may be hampered because of management system and rewarding logics of the PSF: e.g. protective attitudes, competition between groups (created by organizational structure, culture and incentives) and because of plain disgust experts feel for codification task because of their professional identity (see e.g.,

Robertson et al. 2003). Organizational modularity can prevent the emergence of competing groups but of course, incentive systems need to be designed accordingly. Indeed, related to professional identity, willingness to utilise modularity may be relatively low in the beginning because it can be seen as an attack against “professional autonomy”. In the modularity thinking, experts should accept the new role which might shift from comprehensive “customer ownership” (which was prevailing in an autonomous, “every time tailored” way of creating offerings) to a “expertise module producer”, where one’s expertise is part of the wide service concept.

Our data also gave indication to conclude that modularising *internal processes* may be more beneficial than modularising knowledge itself (into knowledge “products”). Based on the knowledge assets utilised, nature and stage of the customer relationship (how much tacit aspects involved based on the history etc.) and service in question (is it based on tacit or easily explicable knowledge, for example), a balance between these two may vary. Process modularity therefore can be seen as means to provide common ways to operate within customer related problem solving whereas the actual solution, developed based on expert knowledge itself cannot, and most likely should not be standardized to too high extent. Unique solutions are needed but their discovery can be facilitated through modularity. An important question of course is, what is “the optimal” degree of modularisation in this context in order to benefit through reduced costs and more efficient processes by using modularity – or on the other hand to keep up with the tacit aspects of knowledge for flexibility and sensitivity considering customer needs? In professional services tacit knowledge is always present.

There are benefits also from customer interaction and participation point of view. The service modularity enables the transforming of the tacit and fragmented organisational knowledge into more codified, thus, more sharable form further increasing area of common understanding with the customer (e.g., Ojasalo 2001). Modularity in the offering facilitates the clear identification of the various elements that the service offering actually consists of making the service more visible to the customer. Hence, the role of the customer in the whole value co-creation process also becomes more visible. This enables the customer to take into account what is required from them during the service development process – when the active customer participation is indeed needed. In other words, modularity facilitates the co-creation of the service.

In addition, modular service offering makes those responsible for customer contacts and professionals working in different customer projects more capable of managing the entirety of a broad and complex service - for example in the project planning stage (see e.g., Jaakkola 2011). In modular service offerings the knowledge attached to the service modules, e.g. in terms of offering variability may be something that actually needs not to be thoroughly communicated and shared with the customer. Complex services may be even more complex to the customer if every little detail needs to be discussed. In fact, this illustrates that consideration should not be put so much into the amount of knowledge to be shared with the customer but more to the quality and nature of the knowledge.

From the service modularity perspective, a beneficial organisational structure would be the same which support organisational learning in general (e.g., Slater and Narver 1995) by creating opportunities for interaction. It can provide forums and means for knowledge sharing and discussion. This may occur through codifying modularity-related knowledge into common IT-systems and further utilising that knowledge in different occasions, but also more

tacit aspects of knowledge can be shared by utilising e.g. liaison positions (like key account management system), integrator roles, matrix organisations and face-to-face contacts. Innovative solutions are created by combining different kinds of expertise in a novel way, and an ability to utilize all potential internal knowledge resources in here in a critical role (see e.g. Cavusgil et al. 2003).

Our study shows that flexibility is needed and in that sense autonomous organisational units can be seen as a benefit related to modularity (Like in Engineering case, for example) On the other hand the danger in loose coupling realizes if organisational procedures guaranteeing sufficient knowledge sharing between subunits are not there. In order to facilitate knowledge transfer, an organization can plan its management and incentive system; culture, structure and metrics accordingly. They all can either support or hamper knowledge transfer and accumulation, and thus customer-related knowledge utilization. In the best case they create a common understanding about the importance of institutionalizing the knowledge.

In terms of future research, it seems that especially the role of knowledge sharing mechanism in professional services would need to be examined along with the service modularity. Our purpose was to examine the nature of the knowledge intertwined into the two different types of PSF contexts, but we did not specifically set out to examine the specific mechanisms that were used within these organizations to facilitate the knowledge sharing as such. Also, the role of management systems related to customer relationships seems importance aspect to service modularity, intertwined to all aspects of it; offering, processes and organization.

To evaluate the quality of our research process, we have employed criteria for trustworthiness developed by Lincoln and Guba (1985). To ensure the dependability of our study, we have focused on building the research process as logically as possible. Although our analysis process has been abductive in nature, we have documented the analysis process to make it as traceable as possible. Transferability has been pursued through explaining in detail the theoretical approaches we have used in our study; theoretical standing points from both KIBS and service modularity discussions. The results of the study can be transferred to other KIBS contexts, where enough similar characteristics can be found. To enable transferability, we have described the empirical context of the study. To increase the credibility, the connection between our findings and existing theoretical knowledge around the theme has been discussed. We have collected the data so that it can be argued to acceptably represent the research phenomena, the service modularity in KIBS. Finally, concerning conformability, we have done our best to show logical links between our arguments and data, for example, through quotations.

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**Appendix 1: Figure 1.**

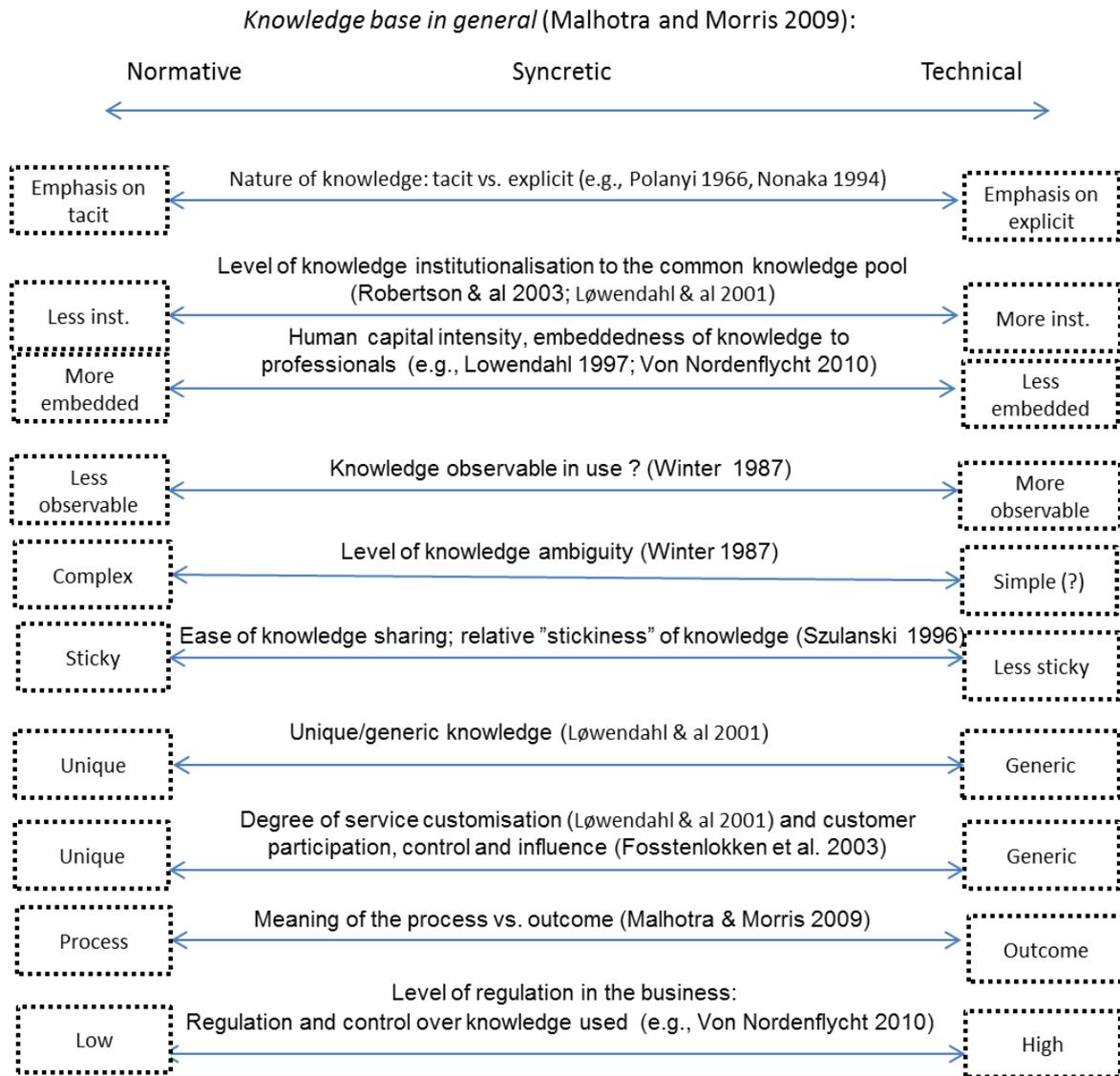


Figure 1. Varying aspects influencing modularity efforts in PSFs

## Appendix 2. Figure 2.

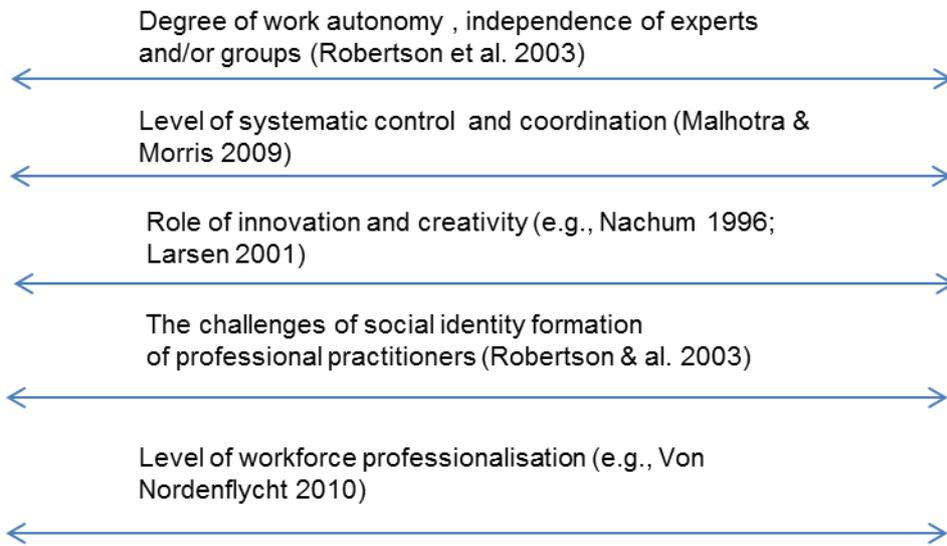


Figure 2. Varying aspects related to management system influencing modularity in PSFs

