



FACULTY OF TECHNOLOGY

Productization of Construction Consultancy Services

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M.Sc. in Product Management

Master's thesis

May 2019



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ABSTRACT FOR THESIS

University of Oulu Faculty of Technology

Degree Programme Masters of Science in Product Management		Major Subject (Licentiate Thesis)	
Author Al-Gunaid Mazen Abdullah Qasem		Thesis Supervisor Haapasalo H, Professor	
Title of Thesis: Productization of construction Consultancy services			
Major Subject Product Management	Type of Thesis Master's Thesis	Submission Date May 2019	Number of Pages 63
<p>Abstract</p> <p>Construction services are considered to still being a traditional industry that hasn't developed much for a long time. Construction consultancy services are classified as one of knowledge-intensive business services that employ professional competences to deliver customer value. Methods used in product manufacturing are studied in the context of service development and production and found to be very beneficial in systemizing of services. In this research, different practices and techniques studied such as modularity and platform delivery of services in the context of service conceptualization.</p> <p>The concept of service co-creation is also studied as a method that enable customer processes and collaborative service delivery. This study of case companies propose the utilization of product structure for construction consultancy services with different methods to achieve efficient services offering and delivery. The study used the available literature of service productization with focus on knowledge-intensive business services and analyses of the current state of case companies in different areas of commercial and technical service structure. It's also researched how services are offered, clarified and described for the customers.</p> <p>Findings show a low level of service systemization among the case companies with some interesting productization efforts in one of the cases. The offering process in most cases is following the traditional customer responsive form in the construction business and highly project centric. Although different challenge found to be hindering the development process of construction services, great potential is found utilizing the product structure. The key components required for achieving the productization of construction consultancy services have been identified based on the literature review and analyses of the results of the cases. The key components identified include different methods and practices that aim to clarify the services offering, increase the value perception, systemize and standardize the service process.</p>			
<p>Additional Information</p> <p>Keywords: productization of services, knowledge-intensive business services, KIBS, construction consultancy services, product structure, product portfolio management, service-dominant logic, modularity in services, service co-creation, service innovation</p>			

Acknowledgment

At the end of this thesis and program which brought me great experience and knowledge in product management. I would like to express my gratitude to all people who supported me in this unforgettable journey for all the efforts, support, and encouragement.

To my professor and supervisor Harri Haapasalo, all Doctors and staff of the Industrial Engineering and management department.

To all case companies persons who collaborated and made this research possible.

To the University of Oulu for giving me this attitude and life-changing opportunity.

To Finland and Oulu, the city which inspired me by its beauty and sharpened my determination by its harsh winters.

And before all

To my mother and father who always believed and gave me everything, hope you are always safe and happy.

To my Family, my loving wife Olfat and my children Abdullah and Zaid who were patient away for one year and moved away from home and everything just to be with me.

To Yemen, my home where I grew up and lived, learned and I will always belong to, hope you get well soon.

Oulu, 21.05.2019

Maze Al-Gunaid

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ABBREVIATIONS

ERP	Enterprise Resource Planning
HSQE	Health, Safety, Quality & Environment
IS	Information system
KIBS	Knowledge-intensive business services
KM	Knowledge Management
KPIs	Key Performance Indicators
PDM	product data management
NPD	New Product Development
PLM	Product Lifecycle Management
SDL	Service-Dominant logic

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(Sääksvuori & Immonen, 2008)

1 INTRODUCTION

1.1 Background

The increasing competition in today's product and services markets driven by the rapid advancement in technologies and disruption of industries necessitate continuous development and adaption by different businesses. Due to service intangible nature and unclear definition service companies often have shortcomings in the development and management of services. The product thinking and methods used by product manufacturers can be used for services for more tangibilization and increase efficiency and quality of services (Sääksvuori & Immonen, 2008). In the case of knowledge-intensive business services (KIBS), there is a particular need for productization to combine different expertise. The most perceived benefit of service productization is making the service more tangible systemized and standardized (Valminen & Toivonen, 2007).

Construction consultancy services are the scope of this study. These services are classified as one of KIBS that highly depend on the expertise. These type of services also lack of service systemization and standardization. The construction industry is considered as one of the least developed (Dubois & Gadde, 2002). The client-led responsive nature of construction professional services causes less efficiency in services delivery (Cusmano, et al., 2015).

In the context of KIBS formalization, this research also comes over the concept of service co-creation as the latest research in the area. Co-creation of services emphasizes the importance of the customer's role in defining and delivering the knowledge-intensive services. It is also emphasized how co-creation can be enabled through a collaborative platform productization approach (Kuula et al., 2018; Pekkarinen & Ulkuniemi, 2008). The cases of construction consultancy services have been chosen as one type of KIBS that is seen to have great potential for improvement and have not been enough researched in this area. The literature of construction consultancy service is found to be scarce especially related to the systemization and development efforts of these services.

1.2 Research scope and objectives

This research aims into exploring and identifying the optimum methods, practices and techniques of service productization in order to achieve cost-efficiency and performance in offering and delivery of services. This research first reviews the literature of service productization concept and the methods by which different services can be systematized and formalized. The research scope is to be fulfilled by answering three research questions as following:

RQ1: How productization of knowledge-intensive services can be utilized to improve the service offering and delivery of construction consultancy services?

This question is to be answered through reviewing the available literature firstly about the general concepts and methods of service productization. After that focused on knowledge-intensive services business. The research then continues more specifically on investigating how the construction consultancy services are being described, defined and organized through productization.

RQ2: What are the main methods, contents, structure, and characteristics of construction consultancy services productization in the case companies?

Based on the empirical research of the case companies, it is aimed to explore the different methods of services offering and structure. It is also aimed to find “to what extent” do these companies understand and use productization concepts and practices. In addition, it is meant to find out what are the prospect advantages and challenges encountered.

RQ3: How should the construction consultancy services be productized to achieve efficient service offering and deliver?

The result of this theoretical and empirical research analyses is to be concluded by answering this question, which identifies the key components by which these companies can successfully productize the services.

1.3 Research process

This thesis consists mainly of two parts, literature review and empirical research. The first part has been covered in chapter 2 which involve a literature review on theory research and background on the relevant topics. The literature review starts with the concept of productization and related methods and drivers. After that, it is focused on the productization of KIBS. Later we try to more specifically research construction consultancy services. The result of the literature review has been synthesized and a framework created for guiding the empirical research (figure 1). The empirical research is following the qualitative research method. The questionnaire is designed based on the theoretical framework to collect information by interviewing company personnel. Multiple case companies are researched to obtain a cross-case comparison and analyses of the results. The collected data start from public information about case companies' portfolios of services and trying to get as much possible information about how these services are offered and how they are commercially structured in the company's websites. The interviews then took a semi-structured form where the interviewed is guided by questions and also the interviewed is allowed to extend and add relevant information.

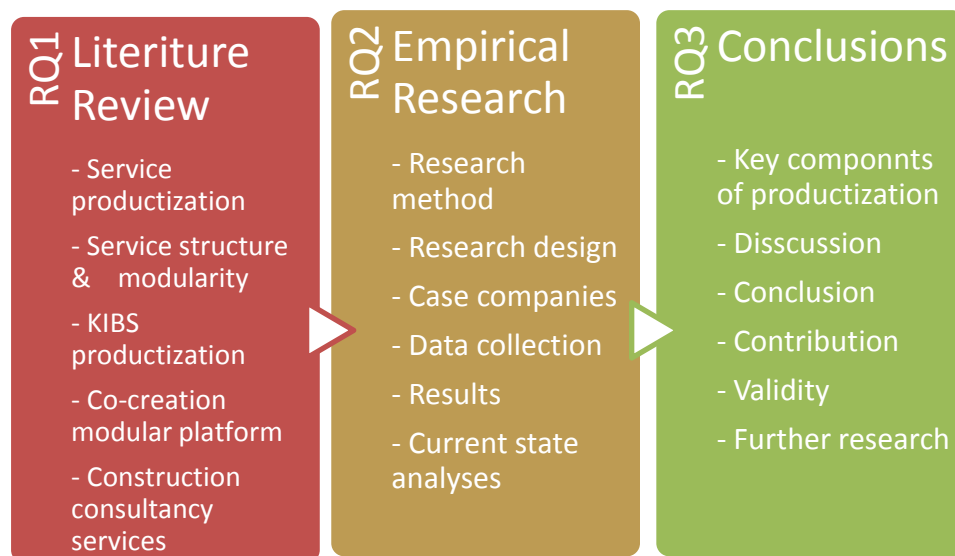


Figure 1. The overall research processes structure and main content.

2 LITERATURE REVIEW

2.1 Service productization

Definitions of key concepts

Product

According to Grönroos (2015), product is “something that can be developed, produced, delivered, marketed and consumed”. Kotler et al., (2016), also define product as, “anything that can be offered to a market for attention, acquisition, use or consumption that might satisfy a want or need”.

While general perception referring to physical goods as products which have tangible nature, the meaning of product is much broader than physical goods as it can include different combinations of services, ideas, experiences. Products can also be intangible such as software or an application. Services are also referred to as an intangible product. A product can be a combination of one or more from physical, non-physical goods and services (Sääksvuori & Immonen, 2008).

Services

Services are defined as “*combinations of outcomes and experiences delivered to a customer*” (Johnston & Clark, 2008). Service can also be defined as one form of products or part of a product that can include other software, hardware or combination of all (Sääksvuori & Immonen, 2008). Services is seen by Kotler et al., (2016) as one form of product that is essentially intangible and consist of as the “*activities, benefits or satisfactions that are offered for sale*”, The main characteristic of services is that it doesn't result into the ownership of anything. Grönroos (2015) defines services by their characteristics of the amount of intangibility in nature, the interaction between the customer and service provider, and/or physical resources or goods and/or systems of the service provider. Services also characterized by the solution that it provides from the provider to the customer. Services usually identified by their distinguishing from manufactured physical goods is the unseparated production and delivery of the services (Johnston & Clark, 2008).

Productization

This research starts from the holistic definition of productization. Productization, in general, can be defined as it appears in the literature as “the process of analyzing a need, defining and combining suitable elements, tangible and intangible, into a product-like object, which is standardized, repeatable and comprehensible. Productization activities cover those for a product to be ready commercially, so it can be produced, delivered, sold, purchased and used” (Harkonen et al., 2015).

Service productization

In the context of service, Järvi (2016) defines productization as a service development approach using practices for “systematizing and concretizing both the service content and service process aims to create a common understanding and to produce the service in a systematic way. Productization has been also researched earlier often in a larger context to mean all the efforts by which customer needs are analyzed and get to be satisfied by developing new products or services whether being tangible products, services or any combination between them (Flamholtz, 1995). The role of Productization consists of “defining, describing, improving, producing and continuously developing the offering so that customer benefits are maximized and the organization’s goals are achieved”. (Simula, et al., 2008).

In a study analyzed the available publications regarding productization, it is found that in the context of services productization referred in the literature can be summarized as the following (Harkonen et al., 2015):

- Making services more product-like
- Defining services better
- Systemizing and creating repeatability
- Making more tangible
- Enhancing and improving services
- Standardization and modularization of services

- Making service production more efficient and profitable
- Combining a tangible product and service offerings.

Benefits and drivers of service productization

Analyses of the key articles in this research that study the concept of service productization practices and techniques, the main drivers for the productization efforts are found to include:

- Standing out from the high competition in markets (Jaakkola, 2011; Valminen & Toivonen, 2009; Valminen & Toivonen, 2007; Chattopadhyay, 2012; Voss & Hsuan, 2009)
- Better service offering for the changing customer needs with keeping customer-orientation (Valminen & Toivonen, 2009; Valminen & Toivonen, 2007; Chattopadhyay, 2012; Simula et al., 2009)
- More efficient services through standardized repeatable processes and methods (Harkonen et al., 2017; Jaakkola, 2011; Chattopadhyay, 2012)
- Marketing drivers through enhanced customer understanding, value perception, concreteness of services and clarifying offering (Harkonen et al., 2017; Jaakkola, 2011; Chattopadhyay, 2012)
- Controllable, improved quality of services (Jaakkola, 2011; Chattopadhyay, 2012)
- Support service growth and scalability as faster onboarding achieved through standardization (Harkonen et al., 2017; Jaakkola, 2011)
- Cost efficiency through modular platform service architecture (Kuula et al., 2018; Bitner et al., 2008; Chattopadhyay, 2012; Pekkarinen & Ulkuniemi, 2008; Simula et al., 2009)
- Enabling and recognition the customer role through customer co-creation processes. (Kuula et al., 2018; Pekkarinen & Ulkuniemi, 2008)

The main driver for conducting productization in services is increasing services competitiveness and cost efficiency. Valminen and Toivonen (2009) argues that using the productization of services approach more efficient competitive services can be

arranged and delivered efficiently in today's increased market competition. It is crucial to clearly define services within the organization especially in professional services. Standardized definition is necessary for services to be clearly understood and different aspects of service content, moreover output possibilities and capabilities need to be clarified within the organization (Sääksvuori & Immonen, 2008).

The need for productization from the case companies' perspective is varied. The need to stand out from competitors has been identified in most cases. Another motivation is also to reduce the workload. In the case of KIBS, there is a particular need for combining different expertise. The most observed benefit of service productization is making the service more tangible systemized and standardized (Valminen & Toivonen, 2007).

Productization is seen as playing a role in systematizing and tangibilization a service offering in which is being clearly understood. It has also a role in formalization of services related processes (Harkonen et al., 2017). Productization of services has also a role in clarifying the service offering, defines the service elements, which are abstract and intangible, making a repeatable standardized offering and raise the understanding of the service content (Harkonen et al., 2015). Through service productization a level of service formalization can be formed, productization can it can be also applicable to some extent of standardization (Harkonen et al., 2017). Chattopadhyay (2012) also claims that productization also client satisfaction improved. Jaakkola (2011) noted the practices of modularity serving the customer perception of the service and increasing the concreteness and tangibility by dividing the service into smaller exchangeable modules.

In the case study, Chattopadhyay (2012) showed that for service products the key achievement through professional service productization is the scalability of service product which enabled by improved efficient service delivery. Moreover, the standardized pre-defined fixed priced offering enhanced service performance at the project level by reducing learning curves and achieving better estimations. The higher level of the whole service economics is also seen to be improved through the life-cycle of the service.

Productization requirements

It is almost agreed in the literature on productization and standardization of services, that the systemization of services start from the definition and standardization of their contained processes (Pekkarinen & Ulkuniemi, 2008; Voss & Hsuan, 2009).

According to Valminen and Toivonen (2009), a key requirement to achieve successful service productization is starting from the understanding of services, having the required resources for productization efforts. It is also emphasized the importance of customer perspective in productization in order to sustain the long-term relationship. Valminen and Toivonen (2007) stated that productization needs a dedicated project and efforts to be implemented.

Simula et al., (2009) divides productization efforts into inbound and outbound activities. Inbound activities are related to systemizing the delivery process of the product within the organization, while the outbound activities related to making the product concrete and visible to the customer to be sold.

Figure (2) illustrates the nature of service productization showing the identified elements at different levels to achieve systematization of services offerings.

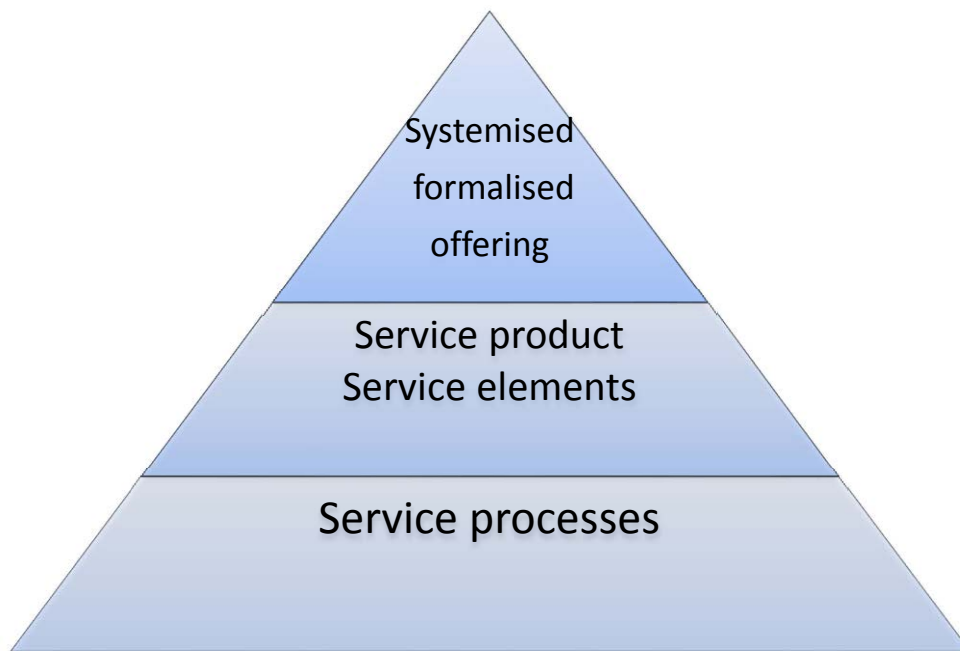


Figure 2. Nature of service productization (modified from Harkonen et al., 2017)

In the context of professional services or KIBS which is the scope of this research, Valminen and Toivonen (2007) has emphasized that regarding small KIBS productization efforts. It is shown that these type of services companies have specificity of requirements depending on the targets and output companies aim from productization of product. The project requires different stages of means that to be implemented consecutively to achieve the targeted output as shown in figure (3). However, it is important to take into consideration these cases of productization projects has targeted new services piloting to the service portfolio, not the existing services.

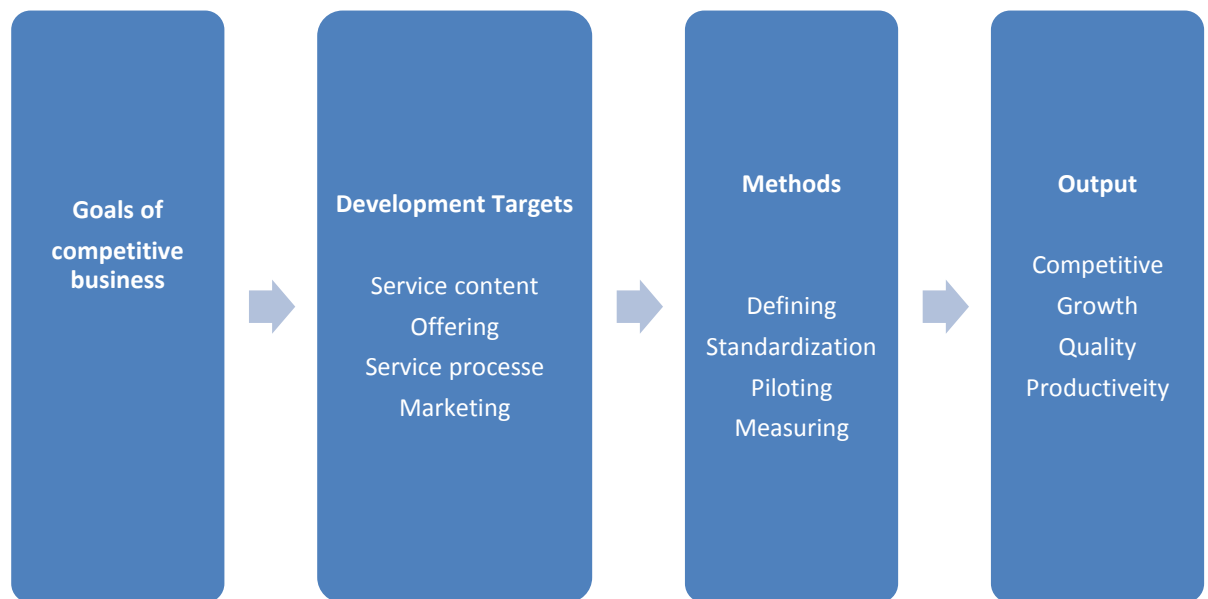


Figure 3. Developing services through productization (modified from Valminen and Toivonen, 2007)

Productization methods

In a comprehensive study on the concepts of service productization Harkonen et al., (2015) identified and extensively studied the different elements of service productization from multiple perspectives as the following:

- Customer orientation: the focus on the customer need and the customer perspective on the service and reflection through service packaging, design, description, and development.
- clarifying and documenting service processes, clearly describing and documenting working methods: mainly internally focused, related to the technical invisible side of the service and link to sub processes and resources
- Definition and configuration of product nature of the service offering and assessing core, supporting and additional services. The emphasize also on customer visibility of service product configuration
- Different tools, practices, and techniques used to productize services such as modularization of services blueprinting, assessing customer benefit, market potential, possible volumes, and competition, piloting productized services.

Service blueprinting

A process generates a service. Customer outcome is created in this process. Developing the service process involves the specification of the activities needed to generate the service (Edvardsson & Olsson, 1996). It is crucial to clearly define services within the organization especially in professional services. A standardized definition is necessary for services to be clearly understood and different aspects of service content, defining output possibilities and capabilities need to be clarified and cleared within the organization (Sääksvuori & Immonen, 2008).

Service blueprinting is a flexible approach that helps in service process design and analysis. It is a powerful technique that can be used to describe a service in different levels of analysis. Service blueprinting can facilitate the detailed refinement of a single step in the customer process as well as the creation of an inclusive, visualization of the whole service process (Bitner et al., 2008). By employing blueprinting vast support is brought in service processes development. Principal activities of service blueprinting include the detailed description of the service process regarding activities and sub-processes, equipment, quality, cost factors, critical points and line of visibility. Costs are calculated in detail and value-based pricing is enabled (Edvardsson & Olsson, 1996). Blueprinting must be carried as much detail as required to document all processes and different branches and sub processes, more specific blueprints are more effective than generic ones. Through processes identification, the service interdependency and sequence is viewed and the service system is visualized using the blueprinting mapping tool. With service blueprinting the company is enabled to see different underlying issues while managing or designing a service. It provides more efficient service development by enabling higher service management (Shostack, 1987). Moreover, Bitner et al., (2008) stated that blueprinting support analyses of the service consumption, co-creation process, and interaction with the service provider is essential in managing this chain of service activities.

According to Bitner et al., (2008), the main Components of Service Blueprints are:

- Customer actions.
- Onstage/visible contact employee actions.
- Backstage/invisible contact employee actions.
- Support processes.
- Physical evidence.

Service modularity

The concept of modularity was originally developed for to physical product architecture; however, the idea has evolved to studying different techniques and aspects involving to operational capabilities, production strategies, innovation processes, organizational structure, and industry evolution (Junarsin, 2010). Pekkarinen and Ulkuniemi (2011) argue that modular service offering and processes have a positive effect in the value perceived by the customer, it can enable raising the reliability of service provider in terms of ability to achieve goals from services with long term relation. Also according to Pekkarinen and Ulkuniemi (2011), modularity within the organization is found to facilitate the project implementation by the customer. Pekkarinen and Ulkuniemi (2011) indicted that standardized services can meet the customer needs if the right portfolio of professional services is made available. Nevertheless, Pekkarinen and Ulkuniemi (2011) found that defining the service modules is more complicated than it seems like any change in modules the customization requires changes in different processes, consequently in costs and resources. Because the invisibility of most service processes it is necessary to understand these activities linked to the client to ensure the value proposition (Bitner et al., 2008).

Platform service delivery

Bask et al., (2010) defines modular system as *“a system built of components, where the structure [“architecture”] of the system, functions of components [“elements”, “modules”], and relations [“interfaces”] of the components can be described so that*

the system is replicable, the components are replaceable, and the system is manageable”.

It’s important to understand the modularity elements and aspects from different contexts (products, production/processes, organizations/supply chains, and services). Table (1) shows the features, interface, and structure of modularity at different styles of modularity in the literature.

Table 1. Styles of modularity (modified from Bask et al., 2010)

Modularity	Product	Interface	Architecture
Product	Component, part, subassembly, function, product characteristics	-Interface between components/parts/subassemblies -Interface between customer and product - Physical/technological interface	Product blueprint
Organization/ supply chain	Member of supply chain, organizational unit, strategic business unit, business model module	Interface between organizations/organizational units, mainly soft/human interfaces, standards, contracts, quality levels	Organization chart, supply chain structure
Service	Service characteristics, types, function	Specification of division of labor, interface between service modules, interface between service and customer, hard technological and soft/human interfaces	Service blueprint
Service process/ service production	Sub-process, process step, service business model module	Specification of division of labor, interface between processes, hard technological and soft/human interfaces	Process map
Service organization/ service supply chain	Member of service supply chain, organizational unit, strategic business unit, service business model module	Interface between organizations/organizational units, mainly soft/human interfaces, standards, contracts, quality levels	Organization chart, supply chain structure

The concept of the platform is equally applicable to services as in products and has been increasingly adopted as a way for sustaining competitive services (Voss & Hsuan, 2009). According to Sakao, et al., (2017), modularization of processes is a key to enables of product service system efficiently and solve the challenges of high customization of services. Modularity in services is also seen as the key to service customization. It provides the bases for customer choices and brings a competitive advantage to the unique services developed (Voss & Hsuan, 2009). Voss and Hsuan (2009) also suggest two ways that can conceptualize the service architecture, one is the hierarchy of service from the industry to the service component and the other is the services platform. Modularity in services is seen also benefiting in handling the complexity in services (Böttcher & Klingner, 2011).

Pekkarinen and Ulkuniemi (2008) have developed a model defining four dimensions of modularity that conceptualize modularity in services shown in Figure (4). The proposed dimensions are service, process, organizational and customer interface. The main challenge in developing modular service platform is also seen by Pekkarinen and Ulkuniemi (2008) to be the coordination among different service modules and interface as well-organized and standardized coordination methods are needed to share the organization knowledge and competencies. The importance of customer interface integration is emphasized through integration into the modular platform. The co-creation of value is also to be considered based on the need for reciprocal relation with the customer.

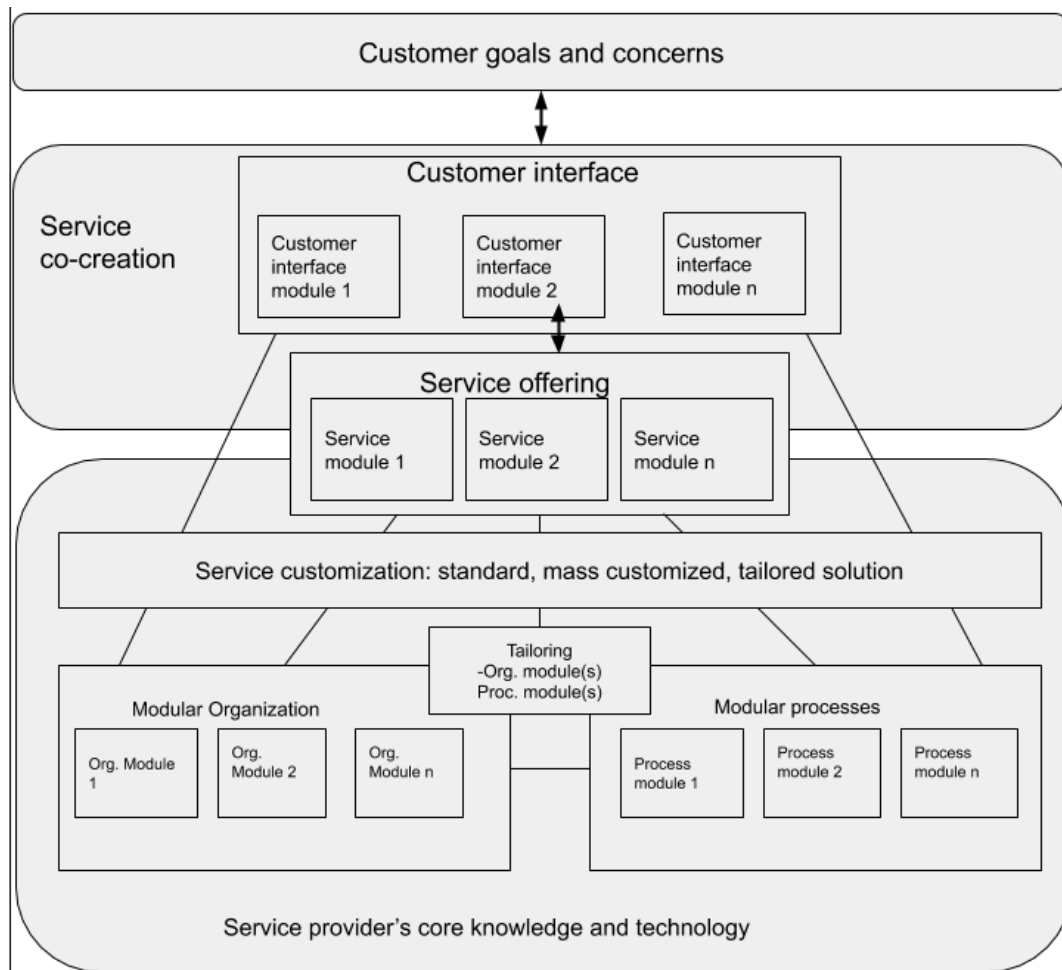


Figure 4. Four dimensional service modularity (modified from Pekkarinen and Ulkuniemi, 2008)

Service product structure

Figure (5) defines the use of the commercial and technical structure of service portfolios and sub-portfolios as presented in the product management/ product portfolio management using (Tolonen et al., 2014). It provides a holistic view of how different services are understood and viewed by different internal and external stakeholders.

Through this layout different services are linked with their processes, sub-processes and required resources. The relevant service productization elements, practices, and techniques identified are shown as the approaches to achieve the systemization, tangibilization, and degree of formalization (Harkonen, et al., 2017).

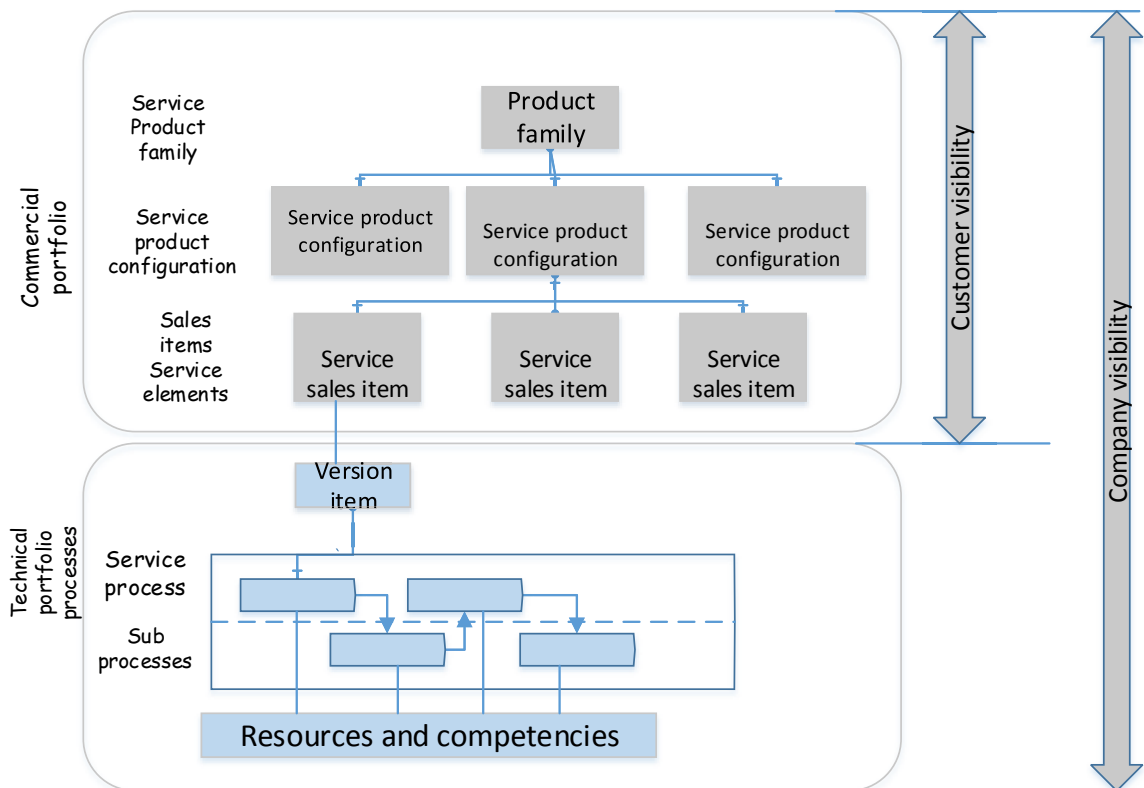


Figure 5. Product structure of services (modified from Harkonen et al., 2017)

2.2 Productization of KIBS & professional services

Nature of KIBS

According to Miles et al., (1995), Knowledge-intensive, business services KIBS are characterized by:

- 1- KIBS rely heavily in professional knowledge
- 2- KIBS can either be the source of information and knowledge such as consultancy, analytics, training or they can use the information they can use their knowledge and information to make intermediate services for their client production
- 3- KIBS mainly supplied to other businesses.

Von Nordenflycht (2010) developed a definition of KIBS companies as referred to them as professional services firms based on three characteristics, the knowledge intensity,

the low capital investment, and professionalism. Other than the traditional classification of knowledge in organizations as tacit and implicit knowledge, De Long and Fahey (2000) classify knowledge into three distinct types:

- 1- Human knowledge which typically has a tacit nature and the most studied
- 2- Social or collective knowledge which is highly tacit and results in effective collaborative work
- 3- Structured knowledge: rule-based knowledge that has implicit nature and enclosed in organization processes and systems.

Service-Dominant Logic (Knowledge exchange and value co-creation)

The emergent SDL by Vargo and Lusch (2008), affirmed the shift of service logic by first stating that knowledge and specialized skills are the substitutional units of exchange, later modified to state that applying the knowledge and skills is the bases of exchange. However, the knowledge is always seen as the main source of a competitive advantage, which later extended to include all operant resources and seen strategic as the main source of benefit (Vargo & Lusch, 2016). However, the value created should always and only perceived by the customer, and the co-creation process including always the customer as part of the value co-creation process (Vargo & Lusch, 2008; Vargo & Lusch, 2016). In Contrary to manufactured goods, the customer in services is an active player in co-production in terms of services quality and added value. Consequently, it is important to clarify the role of the customer in service participation in production (Edvardsson & Olsson, 1996). Aarikka-Stenroos and Jaakkola (2012) findings also highlighted the increased importance of customer collaborative value co-creation processes in KIBS.

Productization of KIBS & professional services

There is a non-clarity in the classification of KIBS as they have been developing quickly and the nature of some KIBS that not only B2B businesses and can be delivered to end customers. Thus it's required to have a detailed description of KIBS company's

activities and services rather than falling under international classifications (Zieba, 2013).

Jaakkola (2011) identified three main practices of productization in among professional services firms:

- 1- Specifying and standardizing the service offering
- 2- Tangibilizing and concretizing the service offering and professional expertise;
- 3- Systemizing and standardizing processes and methods.

It's illustrated by Jaakkola (2011), that these productization practices in the domain of business to business professional services help to solve the problems of the perceived abstract and elusive nature of the professional service. Jaakkola (2011) emphasized the role of productization in the marketing of professional services; it is observed that managers in professional services firms tend to use traditional product marketing practices rather than service marketing. Table (2) shows how professional services can be translated into realizable offering by using productization processes.

Table 2. Productization practices in professional services with productization practices (modified from Jaakkola, 2011)

Perceived problem	Productization practices	Desired solution
Unclear abstract professional services	Tangibilization & clarification	Exchangeable service offering
Individualism and person-centric	Systemizing and standardizing	Efficient controllable production processes

Valtakoski and Järvi, (2016) identified that for KIBS seeking to productize their services to achieve success in the productization process, employee involvement is essential. It has been also emphasized that Frontline employee should share their knowledge about the services in an open collaborative way to succeed in a productization project.

In the context of project-based companies, companies suffer from the lack of productization in their services, which leads to value added to the customer that is not priced properly (Artto et al., 2008). The importance and role of the value-based competence management system as a key function in Knowledge-intensive project organization is stressed. Also based on SDL as core competencies are knowledge and value co-created with the customer and how services development and systemization should be based on employee competencies in order to meet the customer requirements (Kuula & Niemi, 2016).

Modular service platform in KIBS

One of the most intriguing conclusions from the cases studied professional service by productization is that the most of benefits by productization can be accomplished by linking intangible features of the service with the tangible resources and capabilities (Chattopadhyay, 2012). Nevertheless, it didn't discuss the details of which are the methods on how this association can be implemented. In the same contest of professional service business or KIBS most recent research Kuula et al., (2018) suggested a framework for KIBS systemization that takes into consideration the customer co-creation process, which is an essential part in KIBS delivery. The modular platform delivery can be the way to associate different service intangible features offered and the tangible elements and efforts, however, the main focus of Kuula et al., (2018) aim to efficiency on delivery rather than tangiablization of the offering. The framework is composed using the modular platform and based on the product structure/technical and commercial portfolio approach figure (6). At this modular platform model, the service structure is divided vertically based on the customer involvement to the commercial portfolio, technical portfolio of processes consisting of

different processes, competencies, and resources. The third area is the intermediate area between technical and commercial service portfolio which is called the solution platform and presents the delivery processes with customer co-creation activities. The service model provides visibility over the whole structure, processes, sub process, resources, and lines of interaction with the customer.

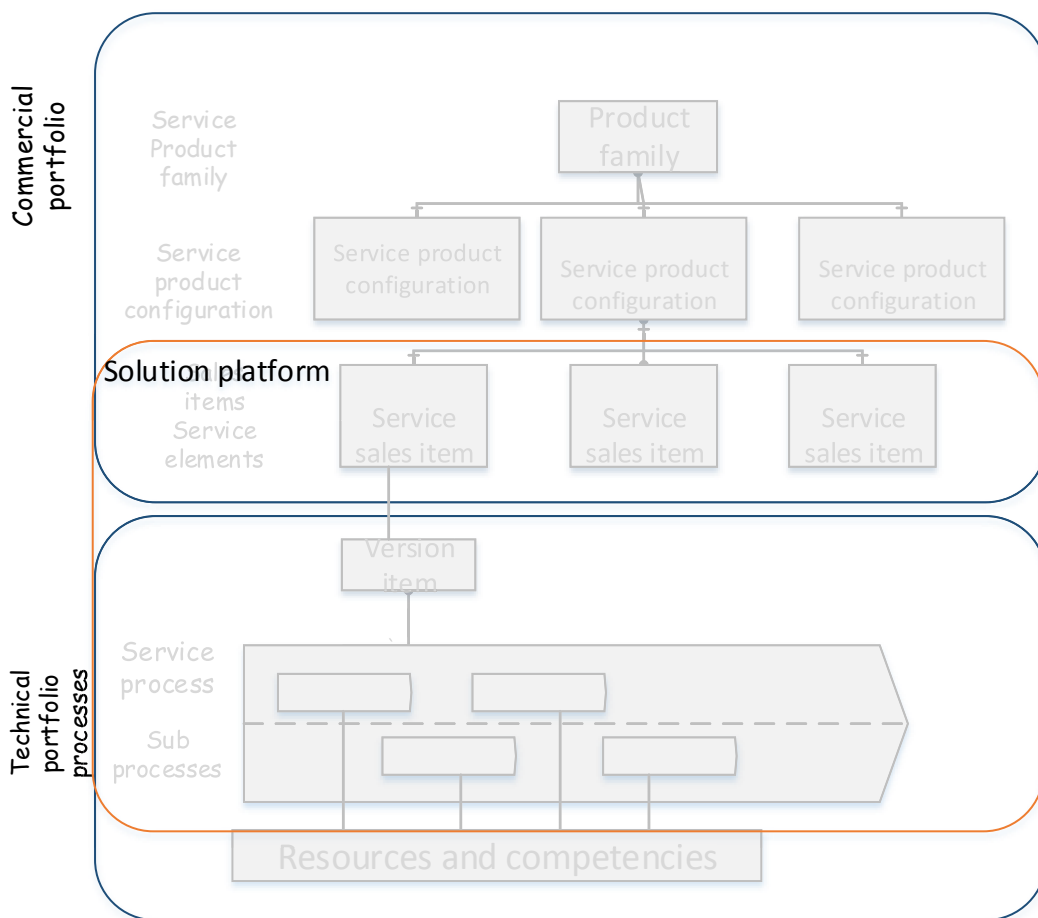


Figure 6. Modular platform service model (modified from Kuula et al., 2018)

2.3 Productization & organizing of construction consultancy services

Organizing construction consultancy services

According to Cusumano et al., (2015), “Architectural, consulting, and most other "professional" services have highly variable, diverse and high complexity in services because they involve a considerable amount of judgment, discretion, and need to adapt

depending on different situations. The issue with Construction professional services firms is that they are often “*client-led*” which means they are responsive to client need made them increase the scope of their competences. That means that they have diversified their portfolio of services and specialties.

A wide range of construction management services are also being offered and adopted by the same firms that involve various disciplines of construction cover all the phases of construction projects (Conner, 1983).

Diversification can bring some advantages as they can meet more customer needs, therefore, increase profitability to some extent by getting more projects and to decrease the operating costs. this increase in the offering can be disadvantageous as more complexity added that require more coordination and resources sharing and no more cost saved (Jewell et al., 2014).

According to Dubois and Gadde (2002), in the construction industry a high concentration on individual project performance affects different performance measures at other projects or the whole construction supply chain. That’s requires a standardized interface among project boundaries. That’s one reason why the construction industry has been less developed than others. Standardization of services is necessary for construction professional services firms in order to maintain the optimum scope and simultaneously meet the customer requirements (Jewell et al., 2014). As knowledge-intensive services of construction also encounter some challenges brought relating to global competition and changes in demand patterns and emergent technologies (Anumba et al., 2005).

Characteristics, organization, service offering & delivery

The construction sector is highly heterogeneous where different companies require very wide expertise and knowledge in different scales and types of projects, however, the common characteristic of all construction companies is that all they can be considered as knowledge intensive. Another characteristic addressed is the location specificity which means that these services are project specific (Miles et al., 1995; Jewell et al., 2014; Jewell et al., 2010)

According to Miles et al., (1995), classification of KIBS Building services (e.g. architecture; surveying; construction engineering but excluding services can be considered as traditional KIBS.

Miles et al., (1995) classification divides KIBS into technology-related and traditional, some of the construction services can be referred under the technology-based KIBS as design services, and new technologies based construction analyses. However, Anumba et al., (2005) also states that construction industry is widely known a one of the knowledge-based industry. Furthermore, the final products in construction as buildings and infrastructure has a high level of tangibility, the industry relies much on professional knowledge and technical expertise.

The service characteristics in professional consulting service usually take a project nature that can take a short or long period up to years and defined by agreeing on the services, deadlines, and deliverables. Therefore, it is necessary for the consulting to be effective that managed a whole taking into consideration the value added for the customer in every process (Bitner et al., 2008).

Productization of construction consultancy services

The literature researching any productization practices or cases specifically in construction services is found to be almost nonexistent. Valminen and Toivonen, (2007) have studied the productization project in small KIBS which to some extent similar to the case of this study especially in case of architectural services office as offering similar construction related professional services.

Because of the project-based nature of construction-related services companies, there has been more focus on project knowledge learning and knowledge management to systemize the services. Knowledge management strategies such as the codification of working processes in KIBS has been early studied as a method to systemize the creative output in KIBS (Bettioli et al., 2012). Moreover, there have been some studies regarding the role of business model importance in the construction industry in general. (Pekuri, 2015) confirmed the importance of the customer as an essential part of the business model in the construction industry. It's emphasized that The value creation process is made for customer value perception.

Pekuri (2015) also concluded of the importance for construction company's success in the long run to be more business-oriented rather than opportunity responsive and ad hoc delivery that can prevent the systemization and scaling of the business. A clear distinction is required between the project management and business management; the project management should be seen as the way of delivering the projects that best serve the business. According to Stroe (2013), recently increase in challenges in the management of engineering design consulting which are not related to technical issues. These challenges are related to how they can keep productive and competitive in today's highly competitive markets. Stroe, (2013) also indicated the issue of the quality of service in engineering consulting and design companies it is too dependent on the professional personnel and how the company can manage them.

2.4 Research Syntheses & theoretical Framework

To synthesize the literature review it is necessary to recall the first research question, which is to be answered by this literature review. The literature targeted to answer the question of what are the ways by which Knowledge-intensive business service can be productized to achieve competitiveness and deliver cost-efficient systemized services. Figure (7) illustrates the synthesized framework from the literature review.

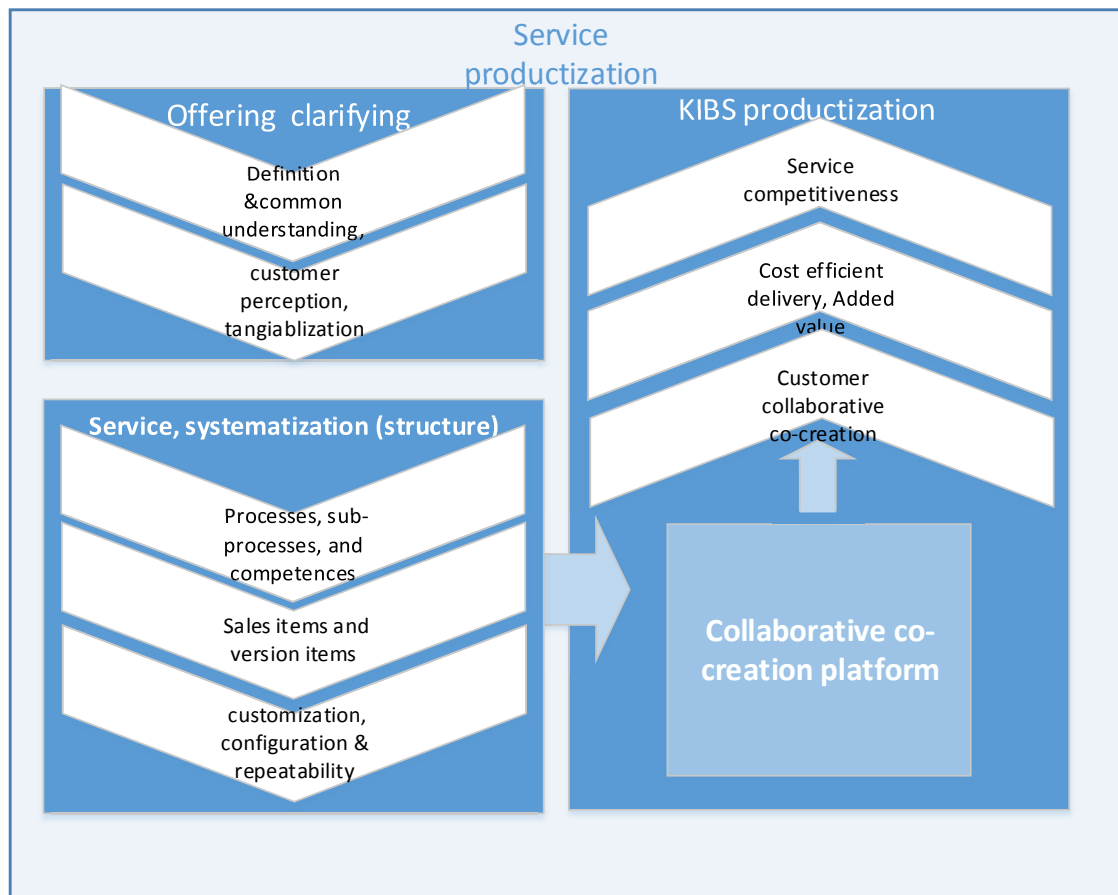


Figure 7. Literature synthesis framework

The literature synthesis can be divided into two main areas based on the context starting from the general concepts and requirements of service productization and moving to the more specific KIBS. The first area can be seen as an enabler and a pre-condition for the second area.

The first part based on and consist of the different generic productization methods. The goal of this part aims to create a systemized, concrete, predefined, repeatable and formalized offering that can be achieved through the following:

- Services product detailed clear description and definition, by creating a common concrete understanding internally and ensure customer understanding of service and precipitation of service value.
- Formalization and systemization through Service structure creation at different levels commercially and technically starting from service processes definition and linking them to different resources and competencies this can be achieved

by the process, sub-processes mapping, service blueprinting and different techniques

- Creation of customization bases from modular pre-defined service elements and defining the different modules of relations and dependencies. The customer should be given the optimum level of visibility of service structure.

The second part is synthesized based on the specificity of KIBS where professional knowledge is the core competence and applying this knowledge is the main exchange based on SDL. The specificity of KIBS requires the collaborative co-creation nature of service delivery. It is also considered more specifically the case of construction consultancy services which is the case of this research:

- The aim in the second area is achieving the cost efficiency in service delivery by employing the platform collaborative service co-creation delivery, (not only doing things right but also doing the right things (Kuula et al.,2018).
- Realization of the value adding through customer creation and all service processes.
- with regards to the most specific scope of construction consulting services, regardless of the scarcely available literature emphasizes the non-technical challenges for this business (Store, 2013). Also the need to be more business oriented and make a clear distinction between the project and business management and focus more on the business orientation (Penury, 2015).

3 RESEARCH METHODOLOGY

This research uses qualitative case approach (Eriksson & Kovalainen 2008). Qualitative research is used to collect information as a useful method to investigate and study the real-life practices and current state analyses (Yin, 2017). Multiple cases have been selected to be individually studied and analyzed. It is mainly aimed to research the use of productization concept and how the companies have described and structured their offering and delivery of services in the current state. Moreover, multiple cases enabled making cross-case analyses of results, support the findings and drawing the common conclusions. (Yin, 2017).

3.1 Research design

The main source of information in this thesis was collected using semi-structured interviews with the concerned expert personnel in the case companies. However, before conducting the interviews the public data of the researched case companies have been explored. Mainly the websites of the case companies have been surveyed to get as much as possible about the company commercial offering, and in what way they have defined their services. This aim for this preliminary research lies into knowing how they have described their offering and what structure of their solutions can be drawn from their portfolio of services. Also trying to construct make a preliminary perception about the level of service conceptualization each company has performed. Figure (8) shows the processes of empirical research.

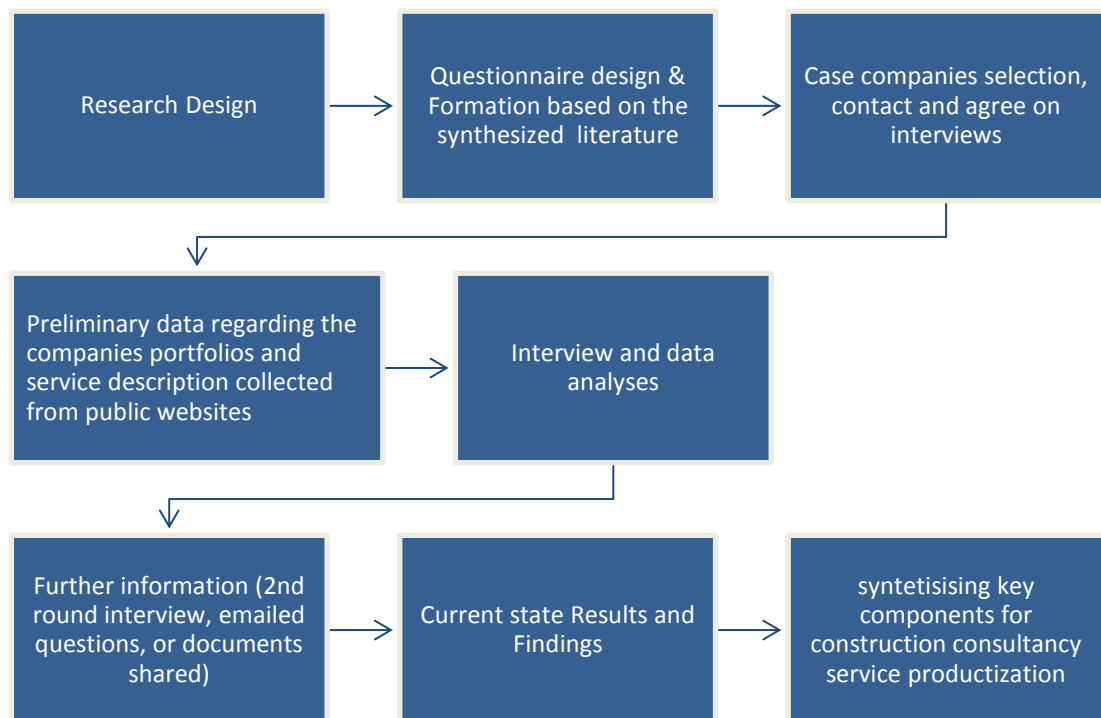


Figure 8. Empirical research process

First, the case companies were selected, contacted and briefed about the research topic and objectives. Face to face, interview time was agreed. After that, the public information and website of the company research have been done to make some idea about the service structure and description. The interviews followed a semi-structured method using a prepared questionnaire to guide the interview. Some points may seem repetitive however; this was meant to emphasize certain by approaching from a different direction to gain some validity and clear results. As semi-structured questionnaire used an open space for further information and discussion to get as much as possible from the interview to analyze. The idea was also that some important points may emerge and brought during the interview.

The questionnaire of the interview has been structured and prepared carefully based on the theoretical framework synthesized from the literature review in chapter 2. The

theory research focused on the relevant and most recent studies in the area of productization and systemization of knowledge-intensive services. Table (3) shows the structure of the questionnaire and the covered topics in the interview. Although the same questionnaire has been used for all the case companies some of the questions can be irrelevant in some cases depending on the degree by which the company has productized and systemized their services and on the level of the detail process definition.

Table 3. Questionnaire structure

Interview questionnaire structure and topics	
Product conceptualization	<ul style="list-style-type: none"> • Service Productization concept familiarity and utilization • Service definition clarification, understanding • Service tangibilization, and Customer value perception
Technical portfolio/Structure	<ul style="list-style-type: none"> • Product / service version identification • Process mapping and visualization • Processes, sub processes definition, standardization and level of detail • value identification and mapping • Processes linkage to resources and competencies
Service Management Product	<ul style="list-style-type: none"> • New service development drivers and logic • service ownership • metrics and KPIs of services at different levels • Cost structure and the price bases
Customer co-creation	<ul style="list-style-type: none"> • Customer segmentation and specificities • Customer role in creation and delivery • Customer processes identification • level and potential of collaboration
Further Discussion	<ul style="list-style-type: none"> • Potential and applicability, thoughts about the concept • Challenges and limitations • Relation to big image (service digitalization, globalization, and disruption)

All interviews have been conducted face to face and voice recorded to obtain and analyses of the whole discussion and response. After the interview, reviewing the recordings and analyses of the collected data, depending on the necessary information a second round interview was arranged for one company with higher management person. Further information asked and sent by email for more clarification in some other cases.

3.2 Case companies

Four case companies have been researched. All case companies are offering construction consultancy services mostly in construction management, project management, and other engineering services. All the companies are delivering their services to both public and private customers. The main operational areas of the companies varied from real estate, infrastructure, and industrial construction. Table (4) shows a summary of case companies and interviews. The case companies varied in size as two case companies are operating under larger group involving a wide portfolio of consultancy and engineering services while two others are small independent companies specializing mainly in project and construction management services. The interviewed persons were all from the high-level management either in the researched business unit in a large company or in a small company. They all have some business responsibility with a knowledge of different services.

Table 4. Case companies summary

Case	Size	Data collection	Interviewed person
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Case	Size	Data collection	Interviewed person
Case1	Large construction services group, engineering design, and consultancy	2 interviews	a- project manager b- Head of the business unit
Case2	SME, independent, construction consultancy, infra, and industrial construction	1 interview, further information asked and sent later	Chief of Development
Case3	Construction consultancy Unit operating under large global group operating in different consultancy areas.	1 interview	Section Head
Case4	SME, construction & project management services	1 interview further company document emailed	Construction Project Manager

4 RESULTS AND ANALYSIS

This chapter consists of two sections. The first section of collected data results which viewed company by company based on the amount of collected relevant information. The second section summarizes and analyzes the current state of studied companies to synthesize the findings of empirical results, which constitute the answer of the second research question.

4.1 Case companies results

Case 1

company overview

The researched business unit in Oulu has quite wide services portfolio of construction management, engineering and project management services mainly in the area of building construction.

Productization and conceptualization

The concept of productization is little familiarized among the interviewed persons. No current development efforts identified.

Service description and commercial offering

The results regarding the description of the services showed that services are described to some level commercially in the public information better than most other cases. This definition brings some commercial understanding clarification of services outcome. Common understanding to some level of services targets and outcome is internally defined, however, there is no common understanding of service value adding by each service and components of these services. Some commercial hierarchy of offering a high level of service families, subfamilies, and some service items from the public website of service portfolio as shown in figure (9). However, these service elements are not defined by the company for service to be configured from.

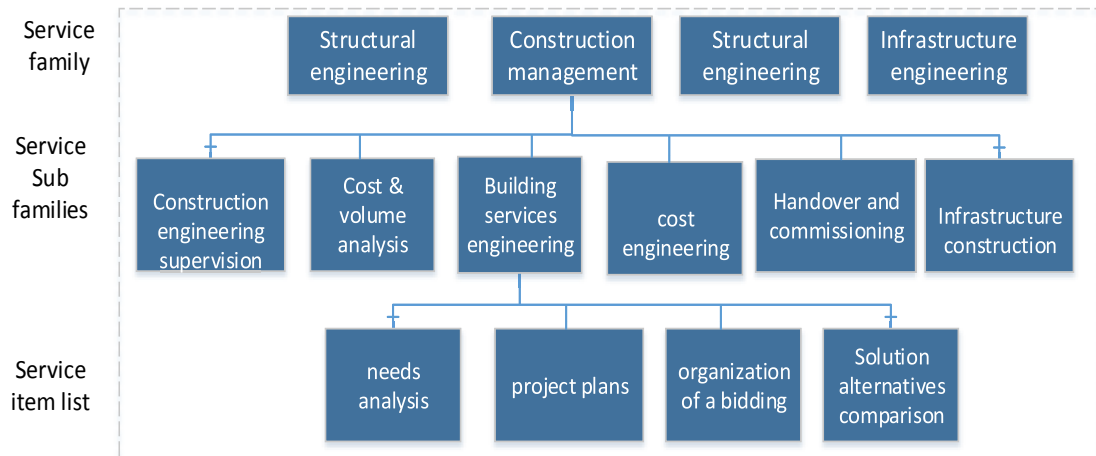


Figure 9. Commercial portfolio based on public information for case 1

Offering, customers and value perception

The offering process is often following the traditional customer responsive form in the construction business and highly project centric. There is a difference among customers in the value perception of services depending on the customer experience and familiarity to construction sector there are some challenges in defining the required services and finding the value of some provided services. These customers usually further collaboration to define the required services. Some challenges regarding clarification of added value to the customer and how company services stand out from other, these challenges are realized by the company and it's accepted that more efforts need to be done about it.

Service sales items, version configuration, customization

The service offering and structure is conceptualized internally to some extent in form of defined standard models of service outcome of different reports, documents, analyses and other forms which service outcome usually start from then that customized for every customer delivery. Services are not clearly recognized as core and other services categories but there is a good realization inside the company of the core services and focus of offering into these services. Sales items are not realized or defined hence the whole package of services is usually sold as a whole solution for construction management, supervision, project management or others. Much of customization in the service often has to be done in every project depending on the size and complexity of

the project. Versions of services are neither defined for different projects deliveries. There is no clear cost structure or pre-definition and visibility of services element cost mainly because services are offered and invoiced based on work hours which is still the case in construction consultancies in general.

Service processes and technical structure

With regards to the technical structure, service technical processes are defined as task lists to some detailed level, some general visualization is there but not in detail, however processes are seen more of part of project processes as task list by the company guidebook. More detail of sub-processes is usually agreed with the customer. Service processes are not linked to required competencies and resources, the optimization of resources is performed using competence management system and depend on the knowledge and closeness of the management to competences inside the company.

Pricing and value mapping

Value in each process is not defined and mapped. The main cost structure is still work hours and there is no tendency into value-based pricing.

Service product management

Services have no assigned owner, all services technically owned by the head of the business unit. On the other hand, there are defined project ownership under the higher business unit ownership. There is no found clear logic for new service development. Moreover, Service performance and KPIs are not measured at the service level but by project and business unit.

Customer collaboration and co-creation

The co-creation of service and close collaboration is usually required with customer especially at early project stage in defining and creation of project competences. However, there is no visibility of internal processes and involvement for the customer. Usually, most of the requirements from the customer are information and decisions, but the level of collaboration is also dependent on the type of the services as some services main goal is to represent and minimize the customer efforts.

Potential of product structure by the company

In overall, the use of product structure is seen to be benefiting the offering and delivery of services especially commercially. As per the interviewed The mostly for better clarification, tangibilization of the value added to the customer

Case 2

Company overview

Company is still relatively small in size to other companies in the area, used to operate as part of a larger group of design and other engineering services but have been recently separated as an independent pioneer in infrastructure construction consulting services. Most services currently are in industrial and infrastructure construction mainly railroads. There is an expansion to other geographic areas and other sectors of real estate building.

Productization and conceptualization

The company undergoes many development efforts of services conceptualization, standardization, and productization. The productization concept is accepted and partially being implemented in the development of services, however, the efforts are still in early stages of implementation with the aim to be the forerunner in this area in the construction industry. With the productization efforts, it's emphasized the openness, innovation in service and bringing soft values to the construction industry and doing things in a different way.

The main challenge for productization efforts as the main client is public transport agent that effect and slows down the process of productizing and service development. The systems of public procurement which mainly concern the pricing as the main requirement from the suppliers. On the other hand, private sector customers there is seen better flexibility that allows the better conceptualize and productize the offered services. The importance of productization is more perceived dealing with clients from other businesses which have no extensive experience regarding the construction or construction management. The learning between projects is also aimed and improved through continuous productization internally as the bases are provided for collective learning.

Offering customers and value perception

There is still high response to client set list of services required because of the high share of the projects is delivered for public customers, however, the chance of conceptualizing has more potential and is being developed for private sector customers. The customer value brought and perceived especially in the area of the private sector is considered in service development and productization efforts. Through process, definition and value added through different processes and setting different tools and application that can support bringing value to the customer that in turn lead to the concreteness of service.

In the commercial structure of services, Different services are offered commercially as solutions that consist of different sales items for offering in a way that shows the value to the customer, throughout the construction project lifecycle. The goal is not only providing expert services but also considering the customer service that extends beyond the project lifecycle.

Product structure

Each service is well defined and described commercially, service processes have been described internally and the development efforts are going to achieve pre-configured service modules to some extent. This conceptualization is known in the company as the internal productization of services. Internal modules defined and from the customer defined goals it's defined which modules are to be used and other additional modules that can be added or also sold separately. The technical process defined for core services processes and independent project process for where the service processes are to be included. Value added is also being mapped in each internal and external process. Competencies and resource management is undergoing development but not yet linked to processes, however, it's planned and going on where it will provide the visibility and need for different service process needs. There is a challenge also of optimization of resources, in platform approach for the construction sector, difficulties in specifying capabilities independent from the project fully devoted resources.

Pricing and value mapping

As typical in these types of services, the current situation is pricing based on work hours. Although The current procurement systems of construction services do not encourage the development of value-based pricing. Value-based pricing is targeted and planned by the company to achieve more productivity and efficiency. Current efforts of services productization are aiming to this with also mapping the value in all processes. Value realization is being improved through process steps, sub process and mapping the value in each process.

Service product management

A clearly defined and followed logic for services development internally. an agile circular development model is adopted that suits the company current size and rapid development efforts. Business unit ownership is currently applied however it's already drafted a Service matrix where different cross-functional services would have their own Service owners. There has not been a need to implement this yet, but it is ready as the company grows. Services performance is being measured by three Basic KPI areas: turnover and profit (financial), customer satisfaction (quality) and employee satisfaction which believed to affect Service quality on expert services tremendously.

Customer co-creation and collaboration

The co-creation concept is also emphasized in development (soft values and cooperation) through emphasizing the collaborative approach among different stakeholders. Co-creation has more focus on new customers as they need to share their strategy, strategic goals and how they can be aligned to the company processes. The co-creation processes are seen as starting from the pre-defined conceptualized core and additional services and then based on the customer needs and requirement these can be configured and tailored

Case 3

Company overview

The studied business unit is offering consultancy of construction management and supervision services and operating as part of a large global group with a diverse portfolio of engineering design and different consultancy services.

Service definition

Services are defined as whole solutions with no sales items identification. Depending on the customer, there can be some cooperation to the customer to understand and define their needs. Service commonly defined by internal guidelines, which externally defined, and the scope is clarified in the offer submitted by the company. In most cases there are no encountered challenges in value perception by the customer, however, there is a need to clarify more sometimes for fewer experience customers.

Offering:

The offering is highly responsive and dependent on client procurement, responsive to customer needs, regulations, and legalization.

Service structure

Services are configured based on the project stage and scope of work. For some projects, there is a packaged service that pre-defined to some extent and visibility on how much competences needed.

Internal HSEQ system defines the processes for each service type. Related guidelines for delivery processes, Management systems. Internal documentation system shows the process defined but not in technical details. Processes are not linked to competencies and resources and Value addition: value added to the customer is not mapped or emphasized. There are some challenges in this area related to estimation and visibility of requirements needed for services and sub-processes as unexpected changes can always happen during projects.

Service management

There is no clear logic for developing of new services within the unit, as the offering is highly client responsive in case new service is needed the competence is procured internally from other units or developed in other units. With regards to service ownership. There is a keeper of the service family within the unit and in the whole company.

Customer co-creation

Customer co-creation is not identified or emphasized. It's seen to depend on client knowledge and experience.

Case 4**Company overview**

The company is quite new and small and still need much service systemization and development of practices

Service offering and structure

The service offering is mostly dependent on project scope. Sales items have not been identified but they are based and derived by the scope of work which is the building information practices promoted among the local foundations and building associations that defines the scope of construction management and supervision services.

Most services are sold as a whole service package and size of the project usually defines whether the whole predefined package is delivered or somehow there is no need for some service elements. Technical processes have not been defined in a detailed way, some guidelines and list of works. There is no service product development logic or model, however, there is some new services are being developed internally which depend in a way on personal competences. Services are offered and charged on an hourly basis with maximum no of service hours and competencies are devoted to the

customer the percentage of the total service cost is also roughly estimated based on the total project budget.

4.2 Current state analysis of the case companies

This section analyzes the current state of the companies in the studied areas. The results are synthesized to answer the research question RQ2 that started as:

RQ2: What are the main methods, contents, structure, and characteristics of construction consultancy services productization in the case companies?

A results synthesis shown in tables (5, 6 and 7) which divided into three main areas of productization conceptualization, service product structure and service product development and management. Which also allows further analyses of results and cross-case analyses to see the critical findings in different areas.

Table 5. Productization conceptualization results summary

Case #	Service clarification and definition	Productization Concept	Value definition	standardization	Pricing Bases
Case1	Clearly described	Not used	Partially clarified	output standardization	Cost hourly based
Case 2	Clearly described	Realized and adopted	Clarified and emphasized	ongoing modules and process standardization	Cost based and developing value-based pricing
Case 3	Partially described	Not used	Partially clarified	output standardization	Cost hourly based
Case 4	Project scope definition	Not used	Partially clarified	output standardization	Cost hourly based

Table 6. Service product structure results summary

Case#	Offering	Sales items	Commercial structure	Process mapping and definition	Competencies and resources link to process
Case1	responsive Solutions	Not defined	Not defined	Defined	Not linked Competence management provide some visibility
Case 2	Solution Sales items, module	Defined	Ongoing development	Mapped and defined in detail	Not linked
Case 3	Total solution customized	Not defined	Not defined	Internal task lists	Not linked
Case 4	Scope task lists	Not defined	Not defined	Not defined	Not linked

Table 7. Service product management results summary

case #	Service development drivers	Product/service development logic	Service ownership	Service metrics KPIs
Case1	Responsive to projects	No defined logic	No Project ownership	Business unit and project
Case 2	Responsive to projects And expanding	Defined and	No Concept drafted will be used as the company grow	Used for service level
Case 3	Responsive to projects	Internally acquired No defined logic	No	Business unit
Case 4	Responsive to projects And expanding	Internally developed No defined logic	No	Business unit

- Results came alike in most areas for all cases except for one case, most cases are almost following the same traditional model of construction services which lack systemization and has a responsive project-centric model of offering and delivering services. On the other hand, one company has mostly adopted the productization of services and found as a pioneer in construction consultancy with the emphasis of service innovation and bringing new values to industry.
- The understanding of productization and using product structure is little familiarized among most interviewed in services however, there is one company has adopted the concept and undergoing development to fully productize the services.
- consulting companies offering still have highly responsive nature to the client. The criteria are usually set by the client. Services highly project dependent; most cases have no defined logic for service development
- Although most of the times services are being sold by companies as whole solutions there is usually many configuration and customization on the service content need to be made from a predefined list of services depending on the scope and complexity of the project.
- In many cases, the most used and relied on practice is (know how to do) which leads to more unsystematized service and mostly hindering the development efforts of the services.
- Service is managed and owned by business unit, measurements and KPIs are not measured for services but project and business unit.
- Internal processes in most cases are developed more to project processes or task lists rather than defining and mapping detailed technical service processes.

- Regardless of all challenges, all interviewed persons clearly could see different benefits and potential of implementing the productization of services for construction consultancy services which can be summarized as brought by the interviewed managers:
 - Standing out from the competitors and enabling to bring new values to the consultancy service and enabling value-based pricing.
 - Tangibilization and concreteness of service by providing the commercial and technical structure and configuration bases.
 - Can be seen as a backbone to adapt to different disruptions in the industry, digitalization of the service and growing globally.

5 MAIN COMPONENTS FOR PRODUCTIZATION OF CONSTRUCTION CONSULTANCY SERVICES

This section answers the third research question of this research. Based on both literature review and empirical results we are able to define the main components required for construction consultancy services to achieve efficient productized services. These components including the critical requirements that are considered as prerequisites for developing the successful structure of service product. (Figure 10) shows the main components for construction consultancy service productization.

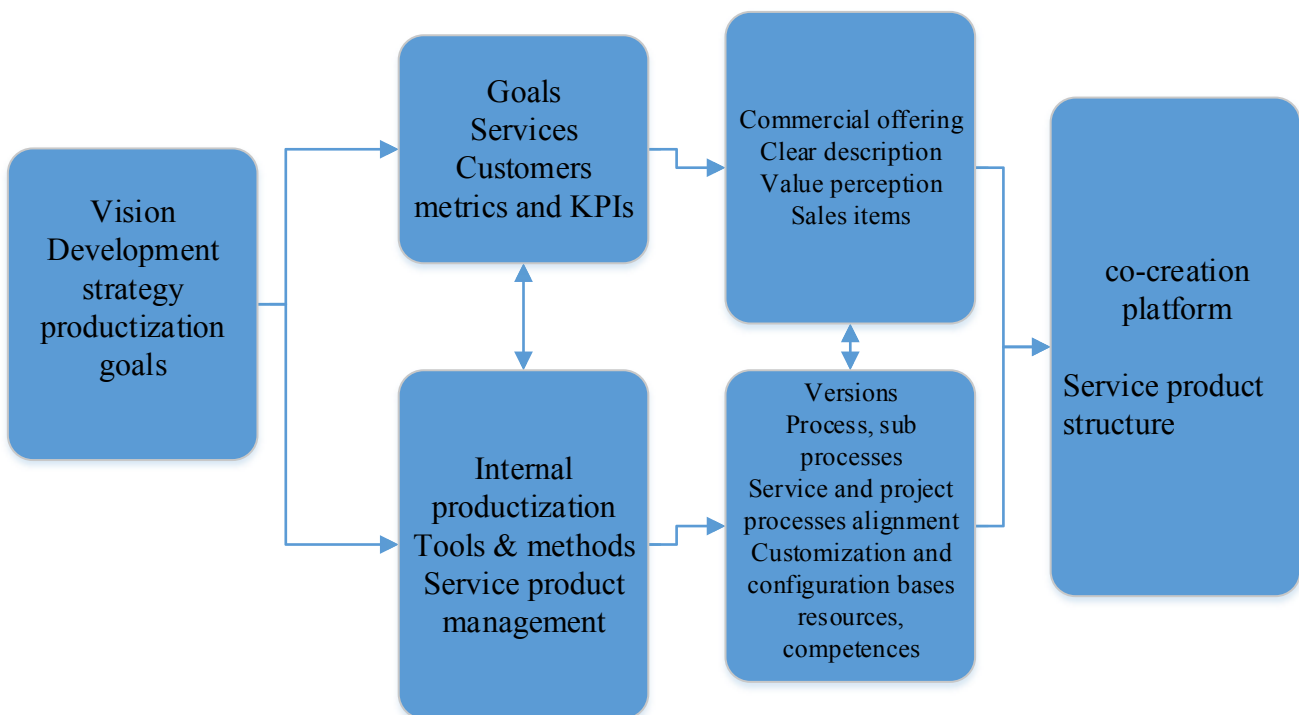


Figure 10. Key components for construction consultancy service productization

The first component for productization is to have a clear development strategy of services by the company. Companies need to define and analyses their current and prospect services, customer segment, customer's goals, and needs. This will enable to identify the goals of service productization, what are the services that need the most

development efforts and for what customers based on their requirements experience of the industry and interests.

The specificity of the construction industry from the difference of customer's goals and experience also the familiarized methods of projects delivery require first to internally productize the services. Internal productization can be achieved by defining, setting and adopting the optimum practice, methods, and tools for the conceptualization of service at different levels. The methods and tools constituent of different configuration, modularity of elements, mapping of processes and customization techniques. The service management practices also to be defined with each service KPIs measurements and technical and service ownership. In line with that, the common understanding of service detail description and goals internally and for the commercial offering is to be built based on the analyses and research of targeted services and customers.

The potential product structure is shown in figure (11) which link the different levels of service product components from the product family, the configuration of service product from defined sales items and corresponding version item. The version item is defined by the processes and sub process at most detail level of different activities. The definition of a service process independently of a project process is a critical element. However, it is important to consider the alignment of these processes and how they are fit into different project deliveries.

Configuration of services is to be enabled from pre-defined sales items. Sales item include a definition of a defined configurable model of service that can be offered and sold separately or as predefined part of a configurable module that is co-created with the client. The co-creation area of the service is to be defined based on the potential customer and service analyses of goals, needs, and interest.

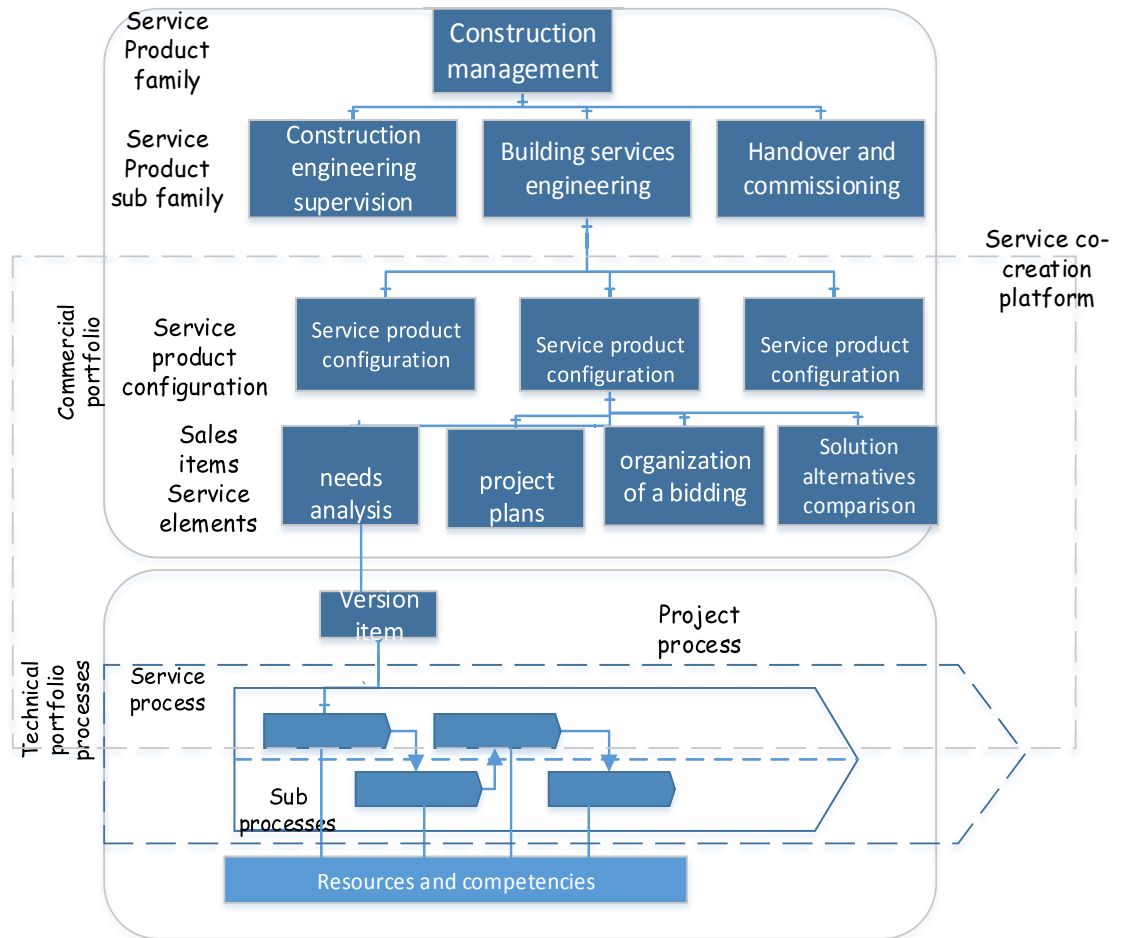


Figure 11. Potential service product structure

The versions of service are important to document and capture the learning of different project deliveries. A new version of the service is defined whenever a significant change due to customization is done to the version of the sales item. These versions of services are maintained and ready for further development and delivery to new customers and provide the bases of collective accumulative learning in the company instead of scattered project deliveries that slow down the learning process and reduce efficiency.

6 CONCLUSION

6.1 Contribution of the study

A significant challenge in systemization and productization of construction consultancy services caused by heterogeneity in customers that result in different offering processes as customers differ in their levels of understanding of services content, value, and interest in service co-creation. Public procurement processes are dominating the norms of responsive offering where customer predefines the bill of services required and expect the least price to be the most critical factor hindering the development efforts. Furthermore, in construction, the consultancy companies work among different stakeholders in the industry, which makes it governed by the norms and ways of offering and delivering the services.

Although the benefits are clear to companies, productization and conceptualization of services efforts require the total openness to change and courage from companies in the traditional sector of construction.

The offering process in most cases is following the traditional customer responsive form in the construction business and highly project centric. Service processes need to be developed and defined independently to provide the technical structure of the service. Service processes need to be mapped and described in most detail way and in a way they also align and fit into project processes.

Regardless of the challenges of industry model of procurement, the productization if services are being implemented effectively in one case company, internal productization is being used and continuous development efforts to fully productization.

The findings came along and supporting the previous studies on professional services systemization and productization. The synthesized and proposed key component represents bases for a multi-level gradual transition from the not systemized service into internally and then fully productize the services. The challenges found for the companies was also considered in defining the key components and requirements.

This study also validated the previous findings of the related studies on the topic by bringing the concept of productization and researching the utilization of the different techniques and methods to the construction industry, which has not been studied, much for this topic.

6.2 Validity and Reliability

A critical challenge for the qualitative researcher is how the scientific nature, quality, and trustworthiness of the research can be shown. Openness and transparency are very important when evaluating the research; however, evaluation needs to be considered not only at the end of research but as a continuous process throughout the research process. (Eriksson & Kovalainen 2008).

According to Yin (2017), four tests are commonly used to test case study research quality. These tests can be used to assess different aspects of research quality that summarized as, construct validity, external validity, and reliability. Internal validity is limited to explanatory studies.

Construct validity mainly concerned about the correct operational measures is used to study the concepts. The framework used in this study has been synthesized based on and using different acknowledged valid previous studies. The empirical research and structure of the interview have been reviewed and approved by two doctors who are experts and have several publishes in the field. The concepts of the framework were shared and explained with the interviewed experts before or during the interview. All interviewed experts showed good understanding and validated the concepts of the framework. More construct validity could be proved by sending the results report to the interviewed experts to know how much they agree with the results. This could not be done during this thesis because of the time limit. However, this still can be done later to improve the validity results specifically if this study is chosen for publishing.

In this study, the **internal validity** has been maintained by trying to design the questionnaire that is the main source of information based on the syntheses of literature. The literature review is narrowed down from the wide concept of productization to the specific knowledge intensive and construction consultancy service. We have taken into consideration the logic behind service productization from goals, drivers, methods, practices, and challenges in order for result to show the whole picture of these services. The empirical research included four different companies to get as much validity as possible. Although some parts of the research topic was shared beforehand, the questionnaire has not been shared before the interview time, which give some credibility of the answers being natural. Internal validity could improve by including more companies and in the research to validate the results. More validity also could have been achieved if more interviews conducted at the same companies to validate the understanding of the concepts and methods investigated.

External validity is investigating if the results can be generalized in what domain, and whether repeating the research will bring the same results. In this study, external validity can be found from the results and findings which reflected lot similarities among the different case companies. The concluded main components of service productization can be generalized for all construction consultancy companies as it set the general guidelines for service systemization. These conclusions have been built based on the validated previous research of KIBS and more validity is added through studying the specificity of construction consultancy services in four different companies in the same industry but different operation areas and different sizes, which support the applicability of results for different construction consultancy companies.

Reliability of data collected and results could be gained in this study through using multiple resources have been used to obtain reliable results. Other than the questionnaire answers, different ways used to collect data starting from public data exploration of websites, asking further information from some companies and making a second round interview with higher management person in one case company. The missing information was collected and questions repeated reflected the validity of previous answers. The questionnaire used for the interviews also formed carefully to validate the answers by approaching some topics from different directions. In this

context, a shortcoming in the reliability could be improved in this study if a more internal perspective could be obtained of the internal processes and more detail level of activities. This could improve the reliability of results but be not possible for some companies as these type of information not shared externally.

6.3 Further research

Some topics have been identified during this study, which seems to be promising and worth further study.

More research can be performed on studying how different systems such as PDM, PLM, and ERP can be used and optimized in the productization processes. How data of product service and project lifecycle can also be leveraged using the productization. Knowledge and competence management systems are also an important area that can be studied in detail and study how this can be used with product structure and in different versions definition of products. In addition, how customer problem approached by co-creation of solution using the platform, of solution.

Another interesting study can be made in detail internally also asses and validate the productization and development in the company that is adopting the productization of services and identifies the challenges, improvements, and implications.

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