CHAPTER 5

Balancing variety and costs in professional services by means of modularity

5.1 Introduction

In an effort to respond to heterogeneous and complex customer needs, professional service organisations provide a large variety of services. Commercial professional service organisations have to realise this in a buyer’s market with fierce competition and price pressure. Also, non-profit professional service providers are faced with limited budgets (Lewis & Brown, 2012). Moreover, customers have become more critical, demand transparency in service delivery, and expect professionals to account for their behaviours in terms of quality and safety (Noordegraaf, 2011). These developments force professional service organizations to properly balance these performance dimensions, that is, providing variety and transparency against reasonable costs. They try to find answers in managerial concepts, like relatively more standardized and formalised work regulations, audit systems, and portfolio concepts for specific customer segments (Noordegraaf, 2011; Evetts, 2003). Recently, modular service design has been proposed as a means for balancing variety and costs in (professional) services (De Blok et al., 2010b; Chorpita, Daleiden & Weisz, 2005; Voss & Hsuan, 2009). While the concept of modularity is associated with low cost provision of variety in production environments (Duray et al., 2000), in professional service settings it is less well developed (De Blok et al., 2010b; Chorpita, Daleiden & Weisz, 2005). Little understanding exists on how modularity could be applied to contribute to balancing costs and variety in the latter settings (Salvador, Forza & Rungtusanatham, 2002).

Modularity in its most abstract sense refers to the ability to decompose a system into modules and recombine a system’s modules (Schilling, 2000). In this concept, providing variety in services against low cost is obtained through pre-specifying a limited number of re-usable modules with standardized interfaces, which can be combined into a variety of service offerings to address heterogeneous customer needs. Much research in operations management tends to treat modularity as a given (Salvador et al., 2002) instead of as a concept that has to be designed into the service offering. The former is also a dominant approach in service modularity research (see

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Gittell et al. (2009), for instance, decomposed the post-surgical care in knee replacements and “anticipated that these three stages of care – hospital, rehabilitation, home - formed the basis for a modular task structure” (Gittel et al., 2009 p. 10). Voss and Hsuan (2009) broke down the total experience of a cruise into describing its elements, the restaurant meals, swimming, entertainment, assuming that this reflected the modular design on a service offering level. Furthermore, engineering management literature questions almost only how to design product modularity into product families and ignores services (Salvador, Forza&Rungtusanatham, 2002). For this chapter, modularity in the design of service offerings is conceptualized as the application of the three modular design principles: specific function, relative independence, and standardized interface (Schilling, 2000; Ulrich, 1995; Duray et al., 2000).

Creating modularity in professional services is challenging as these services are particularly characterized by high levels of input and throughput uncertainty (Lewis & Brown, 2012; Larsson & Bowen, 1989; Von Nordenflycht, 2010). Customer induced input uncertainty refers to “the incomplete information about what, where, when, and how customer input is going to be processed” (Larsson & Bowen, 1989). The level of input uncertainty is determined by two sources: heterogeneity of demands and customer’s disposition to participate in the service process (Larsson & Bowen, 1989). In professional services, customer demands often reflect a high degree of heterogeneity, and the service provider and customer work together to define, produce, and deliver the offerings (Kellog&Nie, 1995). Professional service processes are also generally characterized by high levels of throughput uncertainty (Lewis & Brown, 2012; Von Nordenflycht, 2010). Throughput uncertainty refers to the inability to predict the service process accurately (Milliken, 1987) and is associated with high levels of process variability and a lack of process analysability (Frei, 2006; Perrow, 1970). Professional services are commonly characterized by high levels of process variability and low levels of process analysability (Lewis&, Brown, 2012; Frei, 2006) and thus, high levels of throughput uncertainty.

High levels of input and throughput uncertainties complicate pre-specifying modules and standardizing their interfaces (Rajahonka, 2013). Too much heterogeneity in demand implies that customers require unique configurations and that it is difficult to meet these heterogeneous demands with service configurations consisting of pre-specified service parts (Schilling, 2000). Moreover, pre-specifying a set of modules is further complicated as professional services customer demands become only known as the service delivery progresses (De Blok et al., 2010b; Rajahonka, 2013) and may even then be hard to diagnose, to analyse and to link to pre-specified parts. Also, the low level of process analysability, associated with professional services, hampers the formulation of pre-defined mix and match rules to combine modules and to apply
standardized interfaces to combine modules into a coherent service offering. Despite these apparent obstacles to apply modularity in professional services, interestingly, previous research describes modularity as a response to managing high levels of customer-induced input and throughput uncertainty (Galbraith, 1995; Gittell et al., 2009). In organizational design theory (Galbraith, 1995), it is well-established that one response to manage uncertainty is to decompose work into relatively self-containing elements, which could reduce the information processing need that comes along with high levels of uncertainty. However, less is known on how to decompose a professional service offering into pre-specified modules and how to recombine modules by using standardized interfaces.

Current literature not only provides limited understanding of how to implement modularity into the design of professional service offerings, it also pays limited attention to how modularity in the design of such offerings contributes to the provision of a large variety in professional services against low cost. This study aims: to improve our understanding of how modularity in the design of professional service offerings, could contribute to the provision of a large variety of professional services against low costs.

Although the decomposition of the service offering and the combination of modules are two sides of the same coin in designing modularity in services, in this chapter, specific attention is paid to the combination of modules by using standardized interfaces. Chapters 2 and 4 of this thesis discuss how a professional service can be decomposed into modules. Combining modules by means of standardized interfaces allows the mixing and matching of the modules and plays an essential role in providing variety against low cost, as explained earlier in this thesis (Chapters 1 and 4). In order to achieve this aim, we studied how multiple professional service systems, which differ in terms of input and throughput uncertainties, decomposed their service offering into modules, investigated the combination of the modules by using standardized interfaces and analysed how their modular designs can be expected to create variety at reduced costs.

5.2 Theory

First, a theoretical framework is provided in which we elaborate on the key concepts of this research: professional services, service modularity and balancing variety and costs.
5.2.1 Professional services

Professional services are characterized by high levels of input and throughput uncertainties (Lewis & Brown, 2012; Larsson & Bowen, 1989; Von Nordenflycht, 2010). The level of input uncertainty is determined by two sources: heterogeneity of demand and customer’s disposition to participate in the service delivery process (Larsson & Bowen, 1989). Heterogeneity of demand refers to the uniqueness of customers’ demands, and includes the uniqueness of the customer’s inputs that are to be serviced and the uniqueness of the desired outcomes (Larsson & Bowen, 1989). The presence of customers’ inputs is a necessary and sufficient condition to define a production process as a service process (Sampson, 2010). Customers provide information, belongings, or themselves as inputs of the service production process. This increases heterogeneity and unpredictability in demand and leverages customer-induced input uncertainty (Chowdhury & Miles, 2006). Customer disposition to participate refers to the extent the customer tends to play an active role in supplying labour or information inputs during the service delivery process. The more the service provider and the customer work together to define, produce, and deliver the offerings (Kellog & Nie, 1995), the higher the level of customer-induced input uncertainty.

Throughput uncertainty is associated with high levels of process variability and a lack of analysability (Lewis & Brown, 2012; Perrow, 1970; Abbott, 1988). Process variability refers to the number of exceptions that may occur during a service process (Frei, 2006). For example, in a healthcare setting, two patients may have a similar demand (i.e., hip replacement surgery), yet the operating time and length of stay in the hospital may differ. Another dimension associated with throughput uncertainty is process analysability. When processes have low levels of analysability, there is no objective calculation or procedure to propose a proper response, calling for, what Abbott refers to as “inference” (Abbott, 1988). Inference involves the reflective process that professional staff engages in when the connection between diagnosis and treatment is obscure (Abbott, 1988; Lewis & Brown, 2012). In service offerings with high levels of throughput uncertainty, it is mainly the output of a previous stage that provides direction to the next stage.

Overall, professionals are granted professional autonomy to deal with the high levels of input and throughput uncertainties (Von Nordenflycht, 2010). In some professional service settings, this preference for professional autonomy is highly institutionalized in terms of professional norms (Evetts, 2011; Von Nordenflycht, 2010; Evetts, 2003). For example, a field like law, where the professional association controls access to the ability to practice law and prohibits particular forms of ownership in law firms, has a more professionalized workforce than a field like management consulting (Von Nordenflycht, 2010). A professionalized workforce refers to the presence of two
institutional features of professionalization: ideology and self-regulation. A professional ideology consists of a set of norms, such as the strong preference for autonomy. Self-regulation means that professionalized occupations have strong control over practices of the occupation (Von Nordenflycht, 2010).

Despite its high levels of input and throughput uncertainties, recent research shows that professional service offerings contain more pre-specified ‘reusable’ elements than often assumed. For example, research in a juridical law firm showed that the uniqueness in responsiveness to customers’ demands was found to be constrained through the use of professional standards, organizational standards like planning procedures, and the unique expertise of some professionals that made it legitimate to keep their customers ‘at arm’s length’ in their decision making and to provide supplies with pre-specified elements (Lewis & Brown, 2012). Similar results were found in elderly care; the elderly received customized service plans and customized interactions with helpers concurrent with typically pre-specified elements. Pre-specified elements comprised basic interactions (like ‘hello with a big smile’), highly formalised interaction moments (e.g. formal applications), and templates, forms and formats used to compose the service offering (e.g., the service plan) (Essen, 2008). In summary, more recent research suggests there might be more opportunities for cost-reduction by means of pre-specifying service parts in professional services than has been assumed. This finding implies that there might also be opportunities in professional services for applying the concept of modularity. Below, we will further elaborate on service modularity. In particular, we pay attention to the different modularization strategies that can be used to provide variety at a relatively low cost.

5.2.2 Service modularity

This chapter builds upon the general modular systems theory of Schilling (2000) who views modularity as a general systems concept. In line with this definition, Rajahonka(2013) defines a service module as: “a module can be defined as a relatively independent part of a system with a specific function and standardized interface”. In an analogy to product architecture, Voss and Hsuan(2009) define service architecture as “the way that the functionalities of the service system are decomposed into individual functional elements to provide the overall services delivered by the system”. Despite these definitions, modularity is still a splintered concept (Starr, 2010). Its multi-interpretability is at least partly due to the use of the concept in different contexts, on different levels of abstraction, and its discussion in different research fields that sometimes define and apply it to their own interests (Rajahonka, 2013; Chapter 2 of this thesis). Therefore, we define research boundaries below that allowed us to investigate how to incorporate modularity into the design of professional service offerings.
Drawing on Brusoni (2005) and Chapter 2 of this thesis, we propose that developing a modular service offering involves following decomposition logic. Decomposition logic analyses how a service offering can be systematically broken down into separate modules that according to modularity principles should provide a specific function, be relatively independent, self-containable and have well-defined and standardisable interfaces (Schilling, 2000; Ulrich, 1995; Duray et al., 2000). Following decomposition logic starts with characterizing the heterogeneity of demands that needs to be answered by means of modularity (see e.g., Chapter 3). Also, the boundaries of the service system to be decomposed need to be delineated, in so far as a design choice must be made for what needs to be decomposed into modules. As discussed in Chapter 2, applying the three modular design principles also involves design choices, on which I will briefly elaborate below.

The modular design principle ‘specific function’ refers to the idea that each module is expected to contribute to the overall service offering by fulfilling a specific function. Note that the notion of ‘specific’ is ambiguous because functions can be specified at different levels of detail. Therefore, a subsequent design choice involves the level of specificity of service modules functions. This is discussed in Chapter 2 of this thesis.

The modular design principle ‘relative independence’ refers to the idea that the components that make up the module are tightly coupled, whereas the interdependencies between modules are minimized (Simon, 1962, Campagnolo & Camuffo, 2010; Baldwin & Clark, 2000). In analysing the dependency patterns, we draw upon the three different dependency types as defined by Thompson (1967): pooled, sequential and reciprocal (see Chapters 1 and 2). A modular design should reflect rather loose dependencies between modules, i.e., pooled, and more complex interdependencies between the components that make up the module, i.e., sequential and reciprocal.

In the literature, less clarity exists about the modular design principle ‘standardized interface’ (Voss & Hsuan, 2009, Spring & Bonomi Santos, 2014, De Blok et al., 2014). De Blok et al. (2014) differentiate between interfaces between modules and interfaces between providers who deliver the modules in (healthcare) services. The first interfaces represent linking the integration between modules’ functions. Examples are product books for selection of the functions in demand and planning rules for the order in which to provide the modules that deliver these functions. The second type of interfaces represents the integration between service providers responsible for delivering different modules in a service offering. Examples of the second type are interfaces that reflect coordination mechanisms as a strict division of labour, care dossiers and client meetings (De Blok et al., 2014). Furthermore, De Blok et al. (2014) state that interfaces mainly contribute to providing variety or coherence. Spring and
BonomiSantos (2014) on their turn distinguish between structural interfaces (i.e., interfaces regarding the outcome dimension of service modules) and process interfaces (i.e., interfaces relating to the temporal nature of the delivery of services).

These two conceptualizations of ‘standardized interface’ in modular service design reflect two relevant issues. First, two types of interfaces can be distinguished: functional and organisational interface. Functional interfaces are used to combine the functions of the different modules, i.e. which functions to mix and match. When having decomposed a service offering, some of the functional modules may need to be coupled to provide an integrated service to a customer. In this thesis, we label these interfaces as ‘functional interfaces’ as they link the functional modules of a service offering. De Blok et al. (2014) state that these functional interfaces should make it possible to combine modules in such a way that individual needs can be fulfilled. In other words, these functional interfaces concern the mixing and matching of the outcome dimension of a service offering (Grönroos, 2000) in order to provide customer value.

Both De Blok et al. (2014) and Spring and BonomiSantos (2014) also distinguish a second type of interfaces that integrate the service providers, including customers that may take a participative role in service processes (Kellogg & Nie, 1995). These interfaces, that we label ‘organizational interfaces’, focus on integration of the process dimension of a service offering, i.e., the interactions between the service provider and customers and the activities that need to be performed in order to transform customer inputs into service outputs, that is service specification, production and delivery (Grönroos, 2000). Organizational interfaces involve coordinating work between providers and making ‘interactions among various groups of service providers predictable’ (De Blok et al., 2014, p. 28).

The second issue is the ‘aim’ of using interfaces. While Spring and BonomiSantos (2014) do not explicitly discuss this issue, De Blok et al. (2014) state that interfaces aim at providing coherence and variety. However, both Spring and BonomiSantos (2014) and De Blok et al. (2014) argue that the standardization of interfaces should contribute to reducing the need for information exchange between modules, which implies that standardizing the interfaces should also add to another aim, namely the reduction of (coordination) costs.

Based on this previous research, we adopted in this chapter the following approach. We distinguish between functional interfaces and organisational interfaces. Functional interfaces link content parts with their own specified function, and align the outcome dimension of a service offering. Organizational interfaces link service providers, including customers that are involved in the delivery of (multiple) modules, and focus on aligning the service process dimension. In the next section, we elaborate on how the
three modular design principles, including the distinction between standardized functional interfaces and standardized organizational interfaces contribute to the provision of variety at a relatively low cost.

5.2.3 Service modularity and balancing variety and costs

Below, we will discuss how the three modular design principles contribute to the provision of variety and/or cost reduction.

First, the modular design principle ‘specific function’ mainly contributes to the provision of variety. Different functions can be combined to offer variety in the outcome dimension and to deliver a customized service offering. Moreover, within the boundaries of the function specification, modules’ process dimensions can be adapted during delivery to specific customer needs (i.e., personalization through cut-to-fit modularity). The options to adapt a module to specific needs are related to the specificity of the function of a module. Modules with a general function can be more personalized, whereas modules with a very specific function can be less personalized. Customization differs from personalization as the focus of customization is on the service outcome dimension, whereas personalization refers to the process dimension (De Blok et al., 2012; Voss & Hsuan, 2009).

Second, the modular design principle ‘relative independence’ mainly contributes to the reduction of (coordination) costs, as specific details about the delivery of the module and the coordination between the components can be kept within the module (Chorpita, Daleiden & Weisz, 2005). This implies that coordination within the module can be developed on a module level, and need not be done for each individual delivery. Further, by definition, the dependencies among the modules are weak, which implies that the need for information exchange between modules is minimized.

Third, the modular design principle ‘standardized interface’ plays an essential role in providing variety at relatively low costs. In discussing how this modular design principle contributes to this balance, we refer to functional and organizational interfaces as earlier described. Standardization of functional interfaces refers to the degree to which mix and match rules allow the outcome dimensions of the modules to be efficiently combined with each other (Fixson, 2005). Within this research, we will rely on the work of Ulrich (1995) who, based on the interface condition, distinguished between three types of modular architectures: slot, bus, and sectional. These three types of modular architectures reflect different ways of functional interface standardization. The six modularity types described in Chapter 2 relate to the following three modular architectures. Component sharing modularity, component swapping modularity, cut-to-fit modularity and mix modularity can all be characterized as a slot modular...
architecture; whereas bus and sectional modularity correspond with bus modular architectures and sectional modular architectures respectively (see Figure 5.1).

**Figure 5.1 – Different types of modular service architectures based on interface conditions**

A slot modular service architecture reflects a low level of functional interface standardization as most functional interfaces between modules set many restrictions...
concerning the mixing and matching of modules. Therefore, the various modules can only be limitedly interchanged (Ulrich, 1995). For example, in Chapter 2 we refer to ‘the opening of a patient record’ to be used within different healthcare services and the choice options within travel insurance for ‘global coverage’ or ‘European coverage’ as examples of modules in a modular slot service architecture. These modules’ functions are specified in great detail and only limitedly reflect a similar nature. As a result, these modules can only be limitedly interchanged with other modules. For example, ‘the opening of a patient record’ cannot be interchanged with ‘a blood test’. In the example of travel insurance, ‘global coverage’ can be interchanged with ‘European coverage’. However, these choice options cannot be interchanged with choices regarding the duration of the insurance, e.g., annual travel insurance or travel insurance for a specific period. Thus, within slot modular service architectures, the functional interfaces are specified with a great level of detail and set many module restrictions. As a result, the modules do not all reflect a similar nature, which hampers the mixing and matching of modules into a wide variety of service compositions.

In a bus modular service architecture, there is a basic service offering (i.e., a fixed composition of modules) to which modules can be added or subtracted. The functional interfaces of these modules are of a similar nature (Ulrich, 1995), which makes it relatively easy to interchange modules. In Chapter 2, we refer to the sequence of courses in higher education as an example of bus modular service architecture. In higher education, a predefined set of modules (i.e., specific courses) is determined per educational program, yet students have the freedom to swap, skip or add some courses to their curriculum. As part of the bus logic, rules are formulated in which courses serve as entry requirements to other courses.

In sectional modular service architectures, all functional interfaces are from the same type and there is no basic service offering to which further modules need to be added or subtracted. The modules within a sectional modular service architecture can be mixed and matched with each other in all conceivable ways (Ulrich, 1995). In Chapter 2, we refer to banking services as an example of modular sectional architectures. Within banking services, customer can combine the services offered by a bank (current account, checking account, saving account) in many different ways. Thus, functional interfaces describe the mix and match rules of how modules can be combined and as such, provide detailed insights about how variety in terms of customization can be achieved. If functional interfaces are relatively more standardized, less restrictions concerning the mixing and matching of modules are set and interfaces are from the same nature. As a result, it is easier to recombine modules into a wide variety of service compositions, and more customization can be achieved.
By definition, standardization of functional interfaces reduces costs as they link relatively independent modules in a cost-efficient way.

Standardization of organizational interfaces involves the aligning of work performed by different (professional) service providers, including customers. Drawing upon organizational design theory, we distinguish between three types of coordination mechanisms that involve coordination by standardization: standardization of output, standardization of work processes, and standardization of input, such as knowledge, skills and norms (Galbraith, 1995; Mintzberg, 1980). Standardization of output refers to the pre-specification of output to which all activities within a module should contribute, while leaving how to act and how to perform activities unspecified (Galbraith, 1995; Mintzberg, 1980). Standardization of work processes within the context of a modular design implies that the sequence in which modules are delivered is standardized, e.g., by protocols or process specifications (Galbraith, 1995; Mintzberg, 1980). Finally, standardization of input within the context of a modular design in professional services refers to the notion that one module is delivered by one or multiple practitioners with pre-specified competencies who can, therefore, be trusted to deliver this module in a way that meets professional standards due to their (professional) training (Mintzberg, 1980).

Standardization of the organizational interfaces (co-)determines cost reduction. Table 5.1 summarizes our theoretical exploration.
Table 5.1 - Modularity principles and their contribution to variety and/or cost reduction

<table>
<thead>
<tr>
<th>Modular design principle</th>
<th>Contribution to variety and/or cost reduction</th>
</tr>
</thead>
</table>
| Each module is expected to contribute to the overall service offering by fulfilling a specific function | Variety:  
- Within the boundaries of the outcome definition, a module can be adapted to specific customer requirements during delivery (personalization)  
- Modules with different functions can be combined (customization)  
Cost reduction:  
- A fixed number of modules is pre-specified and this limits customer choice |
| Self-contained refers to the existence of relatively independent modules with intensive interdependencies within modules and weaker interdependencies between modules (loose coupling between modules) | Cost reduction:  
- Minimal dependencies: little information needs to be exchanged between modules, which decreases coordination costs |
| Use of standardized functional interfaces | Variety:  
- A variety of functional modules can be combined to address heterogeneous customer demands (customization)  
- The more functional interfaces are standardized, the more different combinations of modules can be offered  
- Sectional architectures reflect relatively the highest level of standardization of functional interfaces and result in the most variety in services; slot architectures show the lowest level of functional interface standardization and in less options to combine modules  
Cost reduction:  
- The use of mix and match rules provide restrictions and thus restrictions in the level of variety |
| Standardized organizational interfaces | Cost reduction:  
- Use of coordination mechanisms as standardization of input, standardization of processes and standardization of output |

5.3 Methodology

We deployed a multiple-case, qualitative research design involving eight cases. Due to the ‘how questions’ involved in this research, a case study is a valid research method (Voss, Tsikriktsis&Frohlich, 2002). Within our multiple case studies, we take the approach that professionals themselves elaborate on how the concept of modularity, and more specifically, the modularity principle standardization of interfaces, is understood and applied in their service offering. This is a similar approach to what
Rajahonka et al. (2013) applied in their research. This approach is required due to the fact that hardly any organisation applies modularity explicitly in their service offering. Below, we first elaborate on how we selected our cases, subsequently we will describe our data sources and methods and finally, we discuss how we analysed the data.

5.3.1 Case selection

The unit of analysis in all cases is the overall professional service architectures and how this architecture could be decomposed in modules and the recombination of these modules into full service offerings. The cases selected were similar in the following respects: (a.) they all involved a service architecture that reflected multiple professional service offering, i.e., a wide variety of services to one or several target groups; (b.) professionals were the main workforce. To trace common patterns in modular professional service designs, we also deliberately varied on three main dimensions: 1.) the level of input uncertainty; 2.) the level of throughput uncertainty; and 3.) the extent to which professional codes are highly institutionalized, or the service is characterized by a professionalized workforce (see Von Nordenflycht, 2010). Although in all cases the level of input and throughput uncertainties is high when compared to more routine services, there is still some heterogeneity. Case diversity on these dimensions should provide insight into how the degree of input and throughput uncertainties—which is related to the required variety in service delivery (Larsson & Bowen, 1989)—influences the way in which a modular design is applied and how variety in services is provided against reasonable costs. Furthermore, all professional services are provided by highly-educated workers with their unique body of knowledge and expertise. However, some professionals belong to a professional group that have more self-regulatory mechanisms and professional codes for that occupation or field than others. Many of these moreprofessionalized groups are increasingly required to comply with nationally- or internationally-developed guidelines (Armstrong, 2002). This required need for transparency could be related to how the concept of modularity is applied regarding the labelling of modules in, also for external stakeholders, understandable terms. Table 5.2 provides an overview of the cases.
Table 5.2 - Case descriptions

<table>
<thead>
<tr>
<th>Case</th>
<th>Size (in head-count)</th>
<th>Setting</th>
<th>Customer-induced input uncertainty</th>
<th>Throughput uncertainty</th>
<th>Professionalized workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountancy</td>
<td>Medium</td>
<td>Offering of one accountancy firm</td>
<td>High to medium</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Legal advice in commercial market</td>
<td>Single or very small</td>
<td>Offering of four independent agencies</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Ambulant elderly care</td>
<td>Large</td>
<td>Offering delivered by a unit within a care centre</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Dementia care</td>
<td>Large</td>
<td>Offering of an independent care centre</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Spiritual care in hospital</td>
<td>Small</td>
<td>Offering delivered by a unit in a hospital</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Venture Capitalist</td>
<td>Single or very small</td>
<td>Offering of three independent agencies</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Consultancy cultural change</td>
<td>Large</td>
<td>Offering of a consultancy firm</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Marketing advice</td>
<td>Medium</td>
<td>Offering delivered by a unit in a consultancy firm</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>

The size was labelled as ‘single’ if the service system involved only one (typically self-employed) professional. The size was labelled as small if the service system involved two to five professionals; as medium if the service system involved five to ten professionals; and, as large if the service system involved more than ten professionals. The score on customer-induced uncertainty is a relative score and based on the variety in demands and customers’ disposition to participate (Larsson & Bowen, 1989). The customer-induced input uncertainty is considered high when demands for the service offering are highly heterogeneous and involve customers who tend to participate actively in configuring their service offering. Conversely, where demands for the service offering were comparatively homogeneous and the customers were only limitedly involved in the service process itself, customer-induced input uncertainty was classified as low. Customer-induced input uncertainty was classified as medium if the demands for the service offering were somewhat heterogeneous and the customers had some input into configuring their own service offering. Throughput
uncertainty was considered high when it was impossible to predict the entire process. Where the process was linear, and predictable in terms of the nature, number and sequence of activities involved, throughput uncertainty was rated as low. A medium score was attached to throughput uncertainty when the sequence of activities in the delivery process was pre-specified to some extent (Frei, 2006 & Perrow, 1970). For professionalized workforce, we looked at whether the professional workers involved were related to a professional group with high self-regulating mechanisms, such as law, medicine, and accountancy. A ‘high’ score was given if all professionals involved related to a professionalized workforce; ‘medium’ if some of the professionals were related to a professionalized workforce; and, ‘low’ if none or only a few related to a professionalized workforce.

Comparable to the findings of Rajahonka (2013), service providers hardly use the concept of modularity in practice but can consider its application and value. In order to discuss the modularization options, three concrete examples of modular designs were presented and briefly explained. These three examples reflected different decomposition orientations: an outcome-oriented, process-oriented, or a combination of outcome- and process-orientation (see Chapter 2). After explaining these examples, we invited the professionals to discuss which decomposition orientation they recognized in their own service system. One case (ambulant elderly care case) just finished a project to design purposefully a modular design. In all other cases, the professional workers had never heard of modules or a modular design but they all recognized one or a combination of decomposition orientations in their service system. Based on the decomposition orientation, we invited the professional workers to discuss how other modular design choices were made in the design of their service system.

### 5.3.2 Data sources and methods

In seven out of eight cases, two to four interviews were conducted with professional workers, leading to 24 interviews in total. In the ambulant elderly care case, we observed a modular design process and interviewed professionals afterwards about this modular design (see Chapter 4). Interviews followed a semi-structured list of questions (Appendix 4) with the following as main topics: (a.) the description of the service offering(s); (b.) the decomposition logic options (Chapter 2); (c.) the function of the modules created; (d.) the dependencies between these modules and between components in a module; (e.) coordination mechanisms used to align modules; (f.) how variety and cost reduction are/could be created in their modular design; and (g.) the expected value of a modular design. In all cases, additional documents were collected, such as descriptions of projects, process descriptions, strategic plans, and information on price models.
5.3.3 Data analysis

The interview data was first transcribed then coded. Based on our theoretical framing (see Table 5.1), a deductive code list was developed, and all material in the case study database received an initial descriptive code. Table 5.3 shows the descriptive and interpretive codes and an example of an interview quote to which a code was assigned.

Table 5.3 - Coding scheme

<table>
<thead>
<tr>
<th>Quotes</th>
<th>Descriptive code</th>
<th>Interpretive code</th>
</tr>
</thead>
</table>
| Functions of modules were labelled as: “Stay safe and in balance”, “Become fit and mobile” and “Remain fit and active” (ambulant elderly case) | 1. Specific function  
a. Specified in detail | Related to outcome-oriented decomposition and a customer orientation |
| “Our decomposition into these services offer clients payable parts” (legal advice case) | 2. Relative independency  
a. Pooled dependencies between modules | Related, tightly specified service parts and an outcome-oriented decomposition |
| “Based on the scores collected during the basic diagnostic module, the specialist nurse can refer a client to the next module” (ambulant elderly care case) | b. Sequential dependencies between modules | Related to medium-specified service parts and process-oriented decomposition |
| “Based on information collected during the multiple stages [i.e., service parts] we determine during a multidisciplinary meeting what care and services the client need”(dementia care) | c. Reciprocal dependencies between modules | Related to loosely specified service parts |
| “We do not reuse our services [i.e., modules]… we always slightly adapt them in a way so they will fit together properly” (marketing advice) | 3. Standardized functional interface  
a. Slot service architecture | Related to loosely specified service parts |
| “Show the sequence” and “Create a decision tree” (ambulant elderly care case) | b. Bus service architecture | Related to medium-specified service parts and process-oriented decomposition |
| “All combinations of our services[i.e., modules]are possible…” (accountancy case) | c. Sectional service architecture | Related, tightly specified service parts and an outcome-oriented decomposition |
| “Per phase, milestones are specified in close | 4. Standardized | Related to medium |
The further analysis of the data involved two main steps: a within-case analysis and a cross case analysis. For each case, we separately described the proposed decomposition(s) and to what extent the decompositions comply with the modularity principles: specified function, relative independence, and standardized interfaces. We analysed how specific the functions of the decomposed service parts were, and we analysed per case how the interdependencies between the functional parts could be characterized. Based on organizational theory, we characterized the dependencies as pooled, sequential, or reciprocal. Next, we analysed how the modular design principle standardized interface was applied, and we made a distinction between functional and organizational interfaces. The level of functional interface standardization was determined by analysing the service architecture (bus, slot, or sectional) and its related type of interface standardization. We labelled an architecture as ‘slot’ if per-individual customer rules about the mixing and matching were adapted, as ‘bus’ when there appears to be a pre-defined module or combination of modules to which modules could be added or subtracted, and as ‘sectional’ if the functional parts could be recombined in many different ways due to a fixed set of mix and match rules which apply to all customers. Finally, the level of standardization of organizational interfaces was determined by analysing what type of coordination mechanisms were used to align modules into a coherent service offering. We draw upon the three types of standardization: standardization of output, processes, and input. Standardization of output was determined by analysing the extent to which outcomes or milestones per module were clearly specified. Standardization of processes was determined by the extent to which there appeared to be a clear sequence in offering modules. Standardization of input was determined by means of the degree in which it was pre-specified which professional, or which combinations of professionals are responsible for combining modules.
The final step involved a cross-case analysis in which we sought similarities and differences between how the modular design principles were applied, and how the choices in the modular design added to the provision of variety against relatively low costs.

5.4 Results

Below, first we describe how in each case, the interviewees’ views on how the three modularity principles are designed in their professional service offering. We describe how, in each case, functions are assigned to specific parts in the service offering, how self-containing parts are described as a response to the complexity that stems from customers’ demands, and to what extent functional and organizational interfaces were standardized.

5.4.1 Descriptions of the cases

Strategic marketing advice: Within the strategic marketing advice case, professionals recognize a decomposition logic that reflects the stages professionals walk through in delivering their service offering. The professionals all identified three stages: 1.) acquaintance; 2.) writing a proposal; 3.) analysing the problem and providing advice. These stages are always performed in the same order. Each stage or process step has a standard goal. Also, per stage, a standard set of activities is specified, e.g., acquaintance always involves gaining understanding, knowledge and insight about the organization and mapping the problem. Yet, these activities are adapted based upon the customer’s needs and there is much freedom to the professionals in how to coordinate and shape the activities within each stage. Evaluation of results of previous stage is input for adaptations of a subsequent stage.

Venture capitalist: The decomposition described by the venture capitalists reflects a clear sequence of stages the professional follows. Venture capitalists distinguish between: 1.) selection stage; 2.) negotiation stage; 3.) support stage; 4.) exit stage. For the first two stages, a sequence of activities is pre-specified; the selection phase contains: a.) business plan review; b.) informal acquaintance; c.) customer due diligence; d.) informal due diligence; e.) formal gathering; f.) investment decision. All activities are adapted to the customer’s needs. Within the latter two stages, the appropriate activities are selected based on the customers’ needs. For example, the support stage might involve: financial support, HR support, or sales support. Per phase, customer-specific milestones are specified, and based on whether these milestones are achieved, the venture capitalist makes the decision whether to continue to the next stage or not.
**Dementia care:** Within the dementia care case, the interviewees recognized a decomposition logic that reflects the activities that have to be performed in order to submit an older adult to the nursing home. The interviewees distinguished: 1.) pre-phase; 2.) placing in the nursing home; 3.) observation phase; 4.) establishing a life care plan. Per phase, the appropriate activities were selected, based upon client’s needs. The interviewees conceptualized the concept of a module as ‘a shop from which different components could be selected’ instead of a module with highly interdependent components. Each profession could be characterized as such a shop: the doctor provides offerings concerning medication, whereas the physiotherapist provides offerings concerning movement and muscle strengthening. Some of these offerings involved highly standardized activities, such as washing and weighing. Much information needs to be shared to create a coherent service offering. The interviewees specifically mentioned multidisciplinary meetings and (electronic) patient files as coordination mechanisms to achieve system integration.

**Spiritual care:** The interviewees described the decomposition of their service offering as follows: a first stage is acquaintance, which always is followed by one or multiple of the following three parts: 1.) treatment; 2.) approaching death; 3.) religion. These parts can be combined in numerous ways and not each part needs to be included. Each decomposed part consists of several components that involve activities such as thematic conversations with patients, rituals around sensemaking with illness, and paying attention to obstacles in treatment. These parts imply a methodological way of working; within these boundaries the workers are looking for a more personal approach. The patient’s needs, situation and experiences determine the content of the conversations and rituals. Also, additional activities can be added to a module in case of specific needs of patients. Some of the rituals are highly standardized, like going to church together, or praying together. Standard questions structures are used for the communication between the decomposed parts. The answers to these standard questions provide ‘the glue’ between the decomposed parts. Additionally, clients were served by the same employee for the full service package.

**Consultancy cultural change:** The professionals of this consultancy firm apply the value-creation circle and decomposed their offering into the following parts: 1.) mobilize energy; 2.) take ownership; 3.) set direction; 4.) fulfil ambitions and redirect; 5.) inspire others; 6.) change holistically. The formulated goals per decomposed part offer the consultants a frame of reference. Each decomposed part consists out a set of activities. For example, the decomposed part ‘set direction’ can involve the following activities: live through a vision, decide on strategic priorities, analyse and redesign organizational structure, and stimulate corporate story telling. The consultants decide on the combination of activities, and personalize these activities during delivery. Much information needs to be shared between the parts when they are combined. The
overview of the parts provides customers with a sort of ‘product book’. Coordinating the need for information exchange between parts and components is mainly based on ‘the consultant’s expertise’.

**Ambulant elderly care:** Within the ambulant care centre, professionals recognized decomposition into phases over time, as well as a content-based decomposition per phase. First, the service offering was decomposed into the phases: 1.) basic diagnostics, 2.) intensive diagnostics and 3.) treatment. Subsequently, these phases were decomposed into different content-based options. For example, the basic diagnostic phase is decomposed into: a.) psycho-social, b.) psycho-cognitive, and c.) physical and mobility. The functions of the parts reflect different customer benefits and domains of human functioning in which a client can experience a problem. The processes within the modules reflect the use of standardized activities or practices, such as the use of standardized diagnostic tests and therapies. These are explicated in detailed process descriptions, which may or may not involve multidisciplinary meetings and the use of vertical information systems like digital patient files. Although the basic diagnostic parts involve input from different disciplines, a specialist nurse is responsible for the complete intake, or task integration. The overview of the parts provides clients with a product book. Also, the professionals specified interfaces between the different phases in terms of rules (e.g., if score at measure x is a, refer patient to module y).

**Legal advice:** From the interviews, it became clear that the decomposition is in a hierarchical manner. First, the legal advice can be decomposed into: 1.) advising; 2.) sparring; 3.) building a legal foundation; 4.) scanning of documents; 5.) other services. In turn these offerings can be further decomposed into more specific parts. For example, ‘building a legal foundation’ can be decomposed into eight different parts: a.) IT contract; b.) disclaimers; c.) settlement agreements; d.) general terms and conditions; e.) distribution contracts; f.) privacy statements; g.) labour agreements; h.) collaboration agreements. The functions of these parts reflect professional activities. Within each part, different activities can be distinguished, such as ‘intake/identifying wishes’, ‘making a risk assessment’ and ‘sparring/advising on agreements’, but not all activities are required to deliver a part. The legal advisor and customer discuss which parts they think are necessary. In delivering the modules, the professional workers make use of very standardized text fragments: sentences, sections, paragraphs, templates and formats, essentially component sharing modularity. Moreover, due to implicit and highly institutionalized professional codes, the need for information exchange between the parts is minimized. The decomposed parts reflect a product book, and can be recombined in many different ways. A coherent service offering is created by making one legal advisor responsible for each customer, i.e., task integration.
Accountancy services: The accountancy case distinguishes between a wide variety of offerings that all have a specific function, such as providing financial reports, auditing, fraud investigation, salary administration, and tax advice. The functions of these parts reflect different types of activities that these professionals typically can offer. The decomposed parts involve standardized activities and processes, some of which are performed digitally, like in salary administration and tax declarations. As a result, some modules offer more possibilities than others to personalize to individual needs. Due to implicit and highly institutionalized professional codes, the need for information exchange between the parts is minimized. A customer can select one part or multiple parts in any combination, without this increasing the information processing need.

Table 5.4 summarized our main findings per case. We recognized three types of professional service architectures in the case descriptions, each applying different strategies to provide variety against reasonable costs. We elaborate on these three professional service architecture types below.
Table 5.4 – Overview of application of modularity principles in eight cases

<table>
<thead>
<tr>
<th>Specific function refers to</th>
<th>Strategic marketing advice</th>
<th>Venture capitalist advice</th>
<th>Dementia care in nursing home</th>
<th>Spiritual care in a hospital</th>
<th>Consultancy cultural change</th>
<th>Ambulant elderly care</th>
<th>Legal advice to companies</th>
<th>Accountancy services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phases the professional goes through: acquaintance, writing a proposal, analysing a problem, and providing advice</td>
<td>Phases the professional goes through: selection stage; negotiation stage; support stage; exit stage</td>
<td>Phases a professional goes through: pre-phase, placing in nursing home, observation, establish care plan</td>
<td>Different domains in which customers need support: Treatment, approaching death, religion</td>
<td>Different customer benefits or domains in which customers need support: mobilize energy; take ownership; set direction; fulfil ambitions and redirect</td>
<td>Different customer benefits or domains in which customers need support: basic diagnostics psycho-social, psycho-cognitive, and physical and mobility</td>
<td>Professional activities (e.g., sparring; building legal foundation) and to specific service products (e.g., disclaimers, privacy statements)</td>
<td>Professional activities (e.g., auditing, fraud investigation, tax advice)</td>
<td></td>
</tr>
<tr>
<td>Relative independence</td>
<td>Per phase, customer-specific outputs are defined, and accordingly the required inputs, activities, and resources are organized</td>
<td>Per phase, customer-specific outputs (i.e., milestones) are defined and accordingly, the required inputs, activities and resources are organized around these outputs</td>
<td>Construction of content-based parts which can be easily reused and adapted to customer’s needs, e.g., ‘set direction’ involves the standard tool: stimulate corporate story telling</td>
<td>Construction of multidisciplinary content-based parts which can be easily reused and adapted to customer’s needs, e.g., ‘fit and mobile’ can be used in multiple service offerings, but need to be specified per service part</td>
<td>Construction of content-based parts which can be easily reused and adapted to customer’s needs, e.g., ‘fit and mobile’ can be used in multiple service offerings, but need to be specified per service part</td>
<td>Highly independent service parts (based on professional codes); costs are clearly specified per service part</td>
<td>Highly independent service parts (based on professional codes)</td>
<td></td>
</tr>
</tbody>
</table>

Specific function refers to the tasks the professional goes through: acquaintance, writing a proposal, analysing a problem, and providing advice. Relative independence refers to the degree of independence or customisation of service parts with respect to professional codes.
<table>
<thead>
<tr>
<th>Strategic marketing advice</th>
<th>Venture capitalist advice</th>
<th>Dementia care in nursing home</th>
<th>Spiritual care in a hospital</th>
<th>Consultancy cultural change</th>
<th>Ambulant elderly care</th>
<th>Legal advice to companies</th>
<th>Accountancy services</th>
</tr>
</thead>
<tbody>
<tr>
<td>around these outputs</td>
<td>are organized around the outputs</td>
<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
<td>Bus and sectional; all clients first receive acquaintance, which is followed by a combination of other modules followed by a customized combination of other modules</td>
<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
<td>adapted during delivery to individual customer needs</td>
<td></td>
</tr>
<tr>
<td>Functional interface; degree of standardization in terms of modularity type and mixing and matching rules</td>
<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
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<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
<td>Bus and slot; based on the outcome of each phase individual customer mix and match possibilities are formulated</td>
</tr>
<tr>
<td>Organizational interface, type(s) of standardization employed</td>
<td>Standardization of input and due to task integration, the need for coordination is reduced</td>
<td>Standardization of input, and use of care dossiers</td>
<td>Standardization of input and due to task integration, the need for coordination is reduced, some standardization of work</td>
<td>Standardization of input, standardization of output by means of a product book, some standardization of work</td>
<td>Standardization of input, standardization of output by means of a product book, some standardization of work</td>
<td>Mainly bus; rules for combinations of modules that fit well together are formulated, but modules can be added or subtracted</td>
<td>Mainly sectional; all possible combinations of modules are possible</td>
</tr>
<tr>
<td></td>
<td>Standardization of input and due to task integration, the need for coordination is reduced</td>
<td>Standardization of input, and use of care dossiers</td>
<td>Standardization of input and due to task integration, the need for coordination is reduced, some standardization of work</td>
<td>Standardization of input, standardization of output by means of a product book, some standardization of work</td>
<td>Standardization of input, standardization of output by means of a product book, some standardization of work</td>
<td>Mainly sectional; all possible combinations of modules are possible</td>
<td>Mainly sectional; all possible combinations of modules are possible</td>
</tr>
<tr>
<td>Strategic marketing advice</td>
<td>Venture capitalist advice</td>
<td>Dementia care in nursing home</td>
<td>Spiritual care in a hospital</td>
<td>Consultancy cultural change</td>
<td>Ambulant elderly care</td>
<td>Legal advice to companies</td>
<td>Accountancy services</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>standardization of work processes, and use of care dossiers.</td>
<td>processes (mainly in basic diagnostic modules), care dossiers</td>
<td>information systems and digitized work processes</td>
<td>processes</td>
</tr>
</tbody>
</table>
5.4.2 – Balancing variety and costs: Three alternative professional service architectures

Based on the case descriptions presented in Table 5.4, we identified three alternative professional service architectures: ‘loosely specified, professional-oriented’, ‘medium specified, customer-oriented’, and ‘tightly specified, professional-oriented’. The main differences between these professional service architectures are discussed below. An overview of the main characteristics of these professional service architectures is shown in Table 5.3.

Loosely specified, professional-oriented professional service architectures

In the first three cases, i.e., strategic marketing advice, venture capitalist and dementia care for elderly, a process-oriented decomposition approach was applied. In these three cases, the stages in the service delivery process formed the basis for a modular design. These stages are usually offered in the same sequence, and at the end of each stage, it is decided whether the service offering is continued or not. Per stage, a sequence of activities is distinguished. Typical for these cases is also that they hardly specify “what” is delivered in these different stages; the service outcome is only loosely specified. Furthermore, the decomposition in functional parts is developed from a professional perspective, i.e., the starting point in decomposing are the stages professionals go through during the service delivery. Although each part or stage has its own function, the decomposed parts are not self-containing, i.e., information from previous stages is used in subsequent stages. Dependencies between stages or parts are sequential, and sometimes even reciprocal. At the end of each stage, customer-specific mix and match rules are formulated, concerning whether and how the service delivery is continued. As such, the functional interfaces are limitedly standardized and can be characterized as ‘slot’. The dominant form of the organizational interface is standardization of input, i.e., coherence in the service offering was often created by one experienced professional in the daily execution of their work. This reduced the coordination costs. In addition to this, mechanisms with high levels of information processing capacity were used, e.g., multidisciplinary team meetings, to share information between stages in which multiple professionals were involved. Organisational interfaces also involved sharing information with customers; the evaluation of service outcomes of a preceding stage serves as input for the next stage and was a main topic in meetings with customers.

The main focus of this professional service architecture is to provide variety in supply that matches the heterogeneous and customer demands. Based upon customers’ demands, mix and match rules are formulated or adapted. As such, variety is still achieved through a considerable degree of ad-hoc customization. Also, as service parts are only loosely pre-specified, much freedom exists to adapt these service parts during
delivery. Therefore, besides ad-hoc customization, variety is also provided by means of personalization.

Medium specified, customer-oriented professional service architectures

A second type of professional service architecture we identified in the cases is labelled ‘medium specified, customer-oriented’. In three cases: spiritual care, consultancy in cultural change and ambulant elderly care, combinations of both outcome and process-oriented decomposition were applied, which mostly resulted in relatively tighter or medium-specified self-containing parts. This second way of modularization was described by the interviewees as a way of offering both customers and professionals a frame of reference for the options in service offering. Functions of modules were specified in terms of meaningful benefits for potential customers. For example, the treatment phase in the service offering in ambulant elderly care was decomposed in a.) become fit and mobile, e.) stay safe and in balance, and f.) effectively dealing with illness and decline. The functional interfaces in these cases can be characterized mainly as ‘bus’. A general logical sequence in modules offered is traceable. However, within this logical sequence, there is freedom to choose any combination, although some combinations of modules seem to have a closer fit than others. Besides, there is the option to add extra modules. This reflects a sectional architecture. It seems that the formulation of this standardization in functional interfaces can result in higher awareness of how tasks could be allocated to the professional workers. For instance, in the ambulant elderly care case, the development of basic diagnostic modules resulted in the reallocation of these activities from professionals with diverse disciplinary background to a single professional discipline, i.e., a specialised nurse. This reduced the need for information sharing between modules as less time and effort is now needed to align tasks and the tasks are performed by a lower educated (read: lower paid) professional. In other words, these organizational interfaces reflect lower (coordination) costs. The need for information sharing between modules was managed by applying diverse forms of organizational interface standardization, such as rules, actor-activity-diagrams, and procedures.

The focus in this professional service architecture is on providing variety by means of combining medium pre-specified modules and on reducing the coordination costs by means of standardized functional and organizational interfaces. The cases that applied this type of professional service architecture focused on providing variety against lower costs through creating relatively more self-containing parts and minimising the need to process information between modules. Furthermore, an explicit aim was to increase transparency to customers about the professional services the organization could deliver. As the modules were medium pre-specified, variety was also provided
by means of personalization, as during delivery the modules’ process dimension could be slightly adapted based on customers’ needs.

*Tightly specified, professional-oriented professional service architectures*

A third type of professional service architecture we identified in the cases is labelled ‘tightly specified, professional-oriented’. Outcome-oriented decomposition logic can be recognized in these cases, e.g. legal advice to companies and accountancy services. The interviewees described modularization as a way to offer customers “payable parts” and to pre-specify the processes within these parts. Although the professionals wanted to deliver payable parts to customers, the decomposition reflected their professional approach in delivering the service. The cases were characterized by high levels of functional and organizational interface standardization. Due to the high levels of functional interface standardization (i.e., sectional), the functional parts can be combined in many different ways. The service parts are pre-specified in a great level of detail (i.e., tightly specified), which seems to be mainly the result of highly institutionalized practices such as (implicit) rules, laws, and regulation agreements. Due to the pooled interdependencies between modules, the need for information exchange between the parts was regarded as minimized. However, not all parts are completely self-containing as in some cases there might appear a sequential interdependence between the parts, for example “an annual report needs to be finished before tax declarations”. However, limited coordination effort was needed when multiple parts were reused and combined. In the legal advice case, one professional was responsible for delivering a coherent service package.

The main focus in this service architecture was to provide variety against low costs by mixing and matching pre-specified modules. This pre-specification occurred in a great level of detail (i.e., tightly specified) and often these specifications conform to explicit and formalised codes of the professional group. Due to this tight pre-specification, less opportunity exists for adapting modules during delivery (i.e., personalization). Variety was mainly realised through combining modules.

**5.5. Discussion**

This research identified three types of professional service architectures, which reflect different ways in which a large variety of services against reasonable costs can be achieved: loosely specified professional-oriented, medium-specified customer-oriented, tightly specified professional-oriented. These professional service architectures differed in how the three modular design principles were applied and consequently how variety in services against reasonable costs was achieved. This
chapter shows that the design choices concerning the three modular design principles seem to be related. Below, we will first provide a summary of the main findings. Then we will elaborate on how the three professional service architectures relate to the contingencies of input uncertainty, throughput uncertainty, and professionalized workforce. Finally, we will formulate three propositions on how the three professional service architectures contribute to providing service variety against reasonable costs.

5.5.1 Summary of main findings

Table 5.5 provides a summary of the main findings. Table 5.5 shows a pattern in the way modularity in the three professional service architectures is designed and the focus on either variety in service or relatively low costs. More specifically, we show that the uses of more pre-specified modules that are only loosely connected correspond with higher levels of functional standardization and comparatively more output standardization to regulate coordination between service providers. This professional service architecture focuses relatively the most on providing customized service delivery against low cost. On the opposite side, variety is aimed relatively more at where only loosely specified modules are designed so that sequential and reciprocal dependent modules are connected. This architecture has lower levels of functional interface standardization and uses relatively more expensive organizational interfaces as multidisciplinary meetings to discuss deliverables to customers (Fixson, 2002; Sanchez & Mahoney, 2002). Sometimes, the need for organizational interface specification was diminished, as one module previously delivered by several professionals was handed over to one professional, and as many to all modules were delivered by the same professional(s), i.e., task integration. Therefore, this chapter shows the importance of making a conceptual distinction between functional and organizational interfaces, which is also put forward by De Blok et al. (2014) and Spring and Bonomi Santos (2014).
Table 5.5 – Relationship between professional service architectures and modular design principles

<table>
<thead>
<tr>
<th>Specific function</th>
<th>Loosely specified, professional-oriented</th>
<th>Medium specified, customer–oriented</th>
<th>Tightly specified, professional-oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functions are loosely specified and are made specific during delivery</td>
<td>A fixed number of functional parts are medium pre-specified. Within the boundaries of these function specifications, small adaptations can take place during delivery (personalization)</td>
<td>A fixed number of functional parts are tightly pre-specified</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relative independence</th>
<th>Sequential and reciprocal dependencies between the modules</th>
<th>Sequential and pooled dependencies between the modules</th>
<th>Pooled dependencies between the modules</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Standardized interface</th>
<th>Functional interface</th>
<th>Standardized interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level of functional interface standardization. A bus is pre-specified, yet rules of how modules can be attached or not detached; slot architecture</td>
<td>Medium level of functional interface standardization. Sectional and bus architecture</td>
<td>High level of functional interface standardization. Sectional architecture</td>
</tr>
</tbody>
</table>

| Organizational interface | Standardization of input; professionals are responsible for coordination between modules; in case a module is delivered initially by different disciplines and one discipline takes all tasks over, then this task integration reduces the coordination need Multidisciplinary meetings to discuss clients ad-hoc standardization of output | Standardization of input by means of deliberate task allocation, standardization of processes by means of general process descriptions (i.e., the bus), and standardization of output by means of product books | Standardization of input and output based on professional codes. |

| Main focus | Provision of variety by means of ad-hoc customization and personalization | Provide customization and personalization against lower costs | Provide customization against lower cost |

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5.5.2 Professional service architectures and contingencies

Table 5.6 provides an overview of the three professional service architectures types identified in this study, and if there is a relationship between the characteristics of a professional service and the architecture.

Table 5.6 – Overview of the professional service architectures and the service characteristics

<table>
<thead>
<tr>
<th>Professionalservice architecture</th>
<th>Cases</th>
<th>Customer-induced input uncertainty</th>
<th>Throughput uncertainty</th>
<th>Professionalized workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loosely specified, professional-oriented</td>
<td>Dementia care</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Venture capitalist</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Marketing advice</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Medium specified, customer-oriented</td>
<td>Ambulant elderly care</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Spiritual care</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Consultancy cultural change</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Tightly specified, professional-oriented</td>
<td>Accountancy</td>
<td>Medium/high</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Legal advice</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 5.6 shows a relationship between the type of professional service architecture and the levels of customer-induced input uncertainty, and throughput uncertainty and the degree of professionalized workforce. In professional services, characterized by medium levels of input and throughput uncertainties and high levels of professionalized workforce, the ‘tightly specified, professional-oriented’ professional service architecture was applied. In professional services characterized by high to medium levels of input and throughput uncertainties and medium to low levels of professionalized workforce, the ‘medium specified, customer-oriented’ and ‘loosely specified, professional-oriented’ professional service architecture were applied. Thus, it seems that the professionalized workforce influences the degree to which functional parts are pre-specified. Institutionalized professional codes may contribute to the tight specification of a fixed set of modules. The professionals were stimulated or forced through rules and guidelines from the institutionalised professional group to develop a set of relatively independent pre-specified building blocks. This pre-specification of parts in turn makes it impossible for customers to freely specify what they would like to receive. Pre-specifying functional parts based on professional codes and rules is a means of dealing with customer-induced uncertainty (Larsson & Bowen 1989).

Below we will discuss in more detail how the design choices underlying the three professional service architectures affect the balancing between variety and costs. We
will develop propositions concerning how the three professional service architectures contribute to providing a large variety of services against relatively low costs.

5.5.3 Propositions

Based on three professional service architectures described in this chapter, we will present three propositions on how these professional service architectures may contribute to balancing variety and costs. These propositions provide guidance for future research.

With respect to the professional service architecture ‘loosely specified professional-oriented’, we noticed that the interviewees in these cases stated that complex interactions were required between customers and service providers. Much information exchange between the customers and service providers has to take place to define customer demands (Larsson & Bowen, 1989). The need identification and selection of service parts that best fits customer needs were complex and time-consuming activities. Neither the customer nor the service provider had a type of choice option menu from which to select the appropriate functional service parts. As such, the customer and service provider co-created the functional parts and both had a pivotal role in creating a customized service offering. This type of professional service architecture is often described in the studies that research modularity in professional services (De Blok et al., 2010b; Meyer&DeTore, 2001; Meyer, Jekowsky& Crane, 2007). For example, De Blok et al. (2010a; 2010b), state that the need identification and service package configuration are time-consuming activities within modular elderly care. This type of professional service architecture seems to be the least modular as the functions are specified in less detail, there still exists considerable interdependencies between the ‘functional’ service parts, and the functional interfaces are the least standardized. It is, however, difficult to indicate whether these professional service organizations have made fewer efforts to apply modularity in their design, or whether these professional services are less suitable for modularization.

This type of professional service architecture results in the provision of variety, but seems to make less use of functional and organisational interface standardization as a means to reduce costs. Standardization of functional and organizational interfaces may not be possible in these services due to relatively high levels of customer-induced input uncertainty and throughput uncertainty. Within these cases we traced that in these settings, the identification of modules could also stimulate finding ways to reduce costs. For example, by making a single professional responsible for delivering the combination of modules, it diminishes the need for coordination. Moreover, making a highly experienced professional, and possibly a professional who relies on institutionalized, yet tacit rules and forms of inference, may reduce costs in these types
of professional services. However, overall these service architectures are mainly aiming at providing variety. This results in Proposition 1.

**Proposition 1:** The more professional service architectures can be characterized as ‘loosely specified, professional oriented’, the more then that complex information exchange between customer and service provider is required, which in turn results in low functional and organizational interface standardization and rather costly, ad-hoc provision of variety.

The service architectures ‘mediumspecified, customer-oriented’, and ‘tightly specified, professional-oriented’ reflect the three modular design principles more clearly. We elaborate on these professional service architectures below, starting with ‘tightly specified professional-oriented’ professional service architecture.

The ‘tightly specified, professional-oriented’ professional service architectures reflects a pre-defined set of functional parts, which commonly involve professional activities, which are relatively independent (i.e., pooled dependence between the modules). In this type of professional service architecture, choice options are transparent and as a result, customization can be provided in a less ad-hoc manner, compared to ‘loosely specified, professional-oriented’ service architectures. Due to the transparent choice options, customers can easily select the modules that best fit their needs and as such, create a customized service offering. Due to this transparency provided by the professional service architecture, the complex interdependencies between customers and professionals (Larsson & Bowen, 1989) were simplified. The ‘tightly specified professional-oriented’ architectures involve an embedded form of coordination (Fixson, 2005). Due to this embedded coordination, less information needs to be exchanged between modules, and low bandwidth coordination mechanisms can be used during service delivery. The decomposition of the service offering into these functional parts seems to be highly influenced by the professionalized workforce. The ‘tightly specified, professional-oriented’ service architectures are applied in services with a professionalized workforce, and relatively low to medium levels of input and throughput uncertainties. Variety could be provided in a cost-efficient manner. This results in Proposition 2.

**Proposition 2:** The more professional service architectures can be characterized as ‘tightly specified, professional oriented’, the more transparent choice options are created, and the more functional and organizational interfaces are standardized, which in turn result into the provision of customization at reduced (coordination)cost

Propositions 1 and 2 reflect a continuum with, on the one end ‘loosely specified, professional-oriented’ and on the other end, the ‘tightly specified, professional-oriented’ architectures. These professional service architectures mainly vary in the
level of detail in which service parts are pre-specified. Besides the level of detail in which service parts are specified, we found that the orientation used (i.e., customer orientation or professional/provider orientation) to pre-specify these parts also differed. We suggest that in order to deliver person-centred variety, a customer orientation in pre-specifying service parts is a prerequisite. This can offer customers transparent choice options, which in turn may contribute to the feeling of being involved in service delivery. Also, in order to offer person-centred variety, a medium level of detail in pre-specifying service parts also contributes to the provision of person-centred variety. We observed that the cases that applied ‘mediumspecified, customer-oriented’ professional service architecture, pre-specified a set of service parts, but within these service parts, there exists freedom to slightly adapt the service parts, or personalize, to individual customer needs during delivery. Thus, the precise nature of customer’s demands does not need to be known upfront, yet the main differences in customer demands must be known (e.g., by means of a population segmentation, see Chapter 3). Moreover, the focus in this design lies in combining components which certain groups of customers always use together into one module. Due to this particular focus, the dependence between modules is reduced and it is possible to use low bandwidth coordination mechanisms to align modules into an overall service offering. In the third type of professional service architecture modules are medium pre-specified. However, it is the customer-orientation that enables ‘mediumspecified, customer-oriented’ professional service architectures to provide person-centred variety for relatively low coordination costs. This results in Proposition 3.

Proposition 3: It is the customer-orientation within the ‘mediumspecified, customer-oriented’ professional service architecture that results in the balance between person-centred variety and low coordination costs.

5.6 Conclusion

In this paper, we tried to increase the basic understanding of how modularity in the design of professional service offerings in terms of the three modular design principles, (Schilling, 2000; Ulrich, 1995; Duray et al., 2000) could contribute to balancing variety and costs. Our most relevant finding is that three professional service architectures emerged. These three architectures mainly differed in the degree of interface standardization (both functional and organizational) and in the perspective they choose for decomposing their service offering, i.e., a relatively more customer-oriented or more professional-oriented perspective. The first variant labelled ‘loosely specified, professional-oriented’ was aimed mainly at variety with putting only limited
effort in reducing costs. The second variant, the ‘medium specified, customer-oriented’ modularity adopted more of a customer perspective and labelled modules as for customers understandable service values and deliveries and applied some degree of functional and organisational interface standardization. Cases that applied this variant focused on reducing coordination costs through creating relatively, highly self-containing modules and minimising the need to process information between modules. It follows that this variant also contributed to increasing transparency and accountability due to the pre-specification of functional parts. The third professional service architecture ‘tightly specified, professional-oriented’ aimed to reduce costs through developing tightly specified and easy reusable parts based on institutionalized professional codes and rules. Information processing needs between parts was minimised as well. In the two cases that applied this third variant, the legal advice and the accountancy cases, the professionals were stimulated or forced through rules and guidelines from the institutionalised professional group to develop more standardized building blocks.

Further, we noticed the important role of task integration in the modular designs. In the ‘loosely specified, professional-oriented’ variant, professionals often executed an entire self-containing part on their own. This implied that the coordination ‘burden’ of interdependent tasks was executed by a single professional, which diminished the advantages of creating self-containing parts. In the ‘medium specified, customer-oriented’ variant, the coordination task within a self-containing part was also allocated to a single professional, however, this happened only after the tasks within the self-containing parts as well as the coordination within this part and between parts were highly explicated and formalized. Therefore, a relatively lower educated professional could execute all the activities within these parts. This shows how, in the second professional service architecture type, costs could be lowered in two ways: the use of low bandwidth coordination mechanisms and the execution of tasks by lower-educated employees.

5.6.1 Limitations and future research

A major limitation of this study is that only one of the cases applied a deliberately designed modular supply. The difficulty that we approached during this study was that modularity and associated concepts discussed in this thesis were not (yet) explicitly used in the practices studied. A modular way of working had only been deliberately chosen by one case organization (i.e., the case organization where we also researched the modular design process). All other cases had not deliberately designed their service offerings in a modular fashion. As the service providers were not familiar with the concepts used in this thesis, misinterpretation was a risk. We provided the interviewees with figures and examples of modular service designs to (partly) overcome this risk.
Also, after explaining to the interviewees the concept of modularity, we carefully checked whether they understood the main modular design principles, by asking them to describe the modular design choices made in their service offering.

Future research could focus on modular design processes through analysing and comparing service offering designs that have been more deliberately designed in accordance with modularity principles. Moreover, by comparing different, deliberately designed modular service offerings, future research could also systematically evaluate the effects of such designs on actual performance. Thus, does a customer perspective indeed result in a better balance between variety and coordination costs compared to a professional perspective? The three propositions formulated in this research provide a starting point for future research.