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# Typology for Modular Service Design: Review of Literature

*Tuure Tuunanen, University of Oulu, Finland Anu Bask, Academy of Finland, Aalto University School of Business, Finland Hilkka Merisalo-Rantanen, Aalto University School of Business, Finland*

**Abstract:** The aim of this paper is to present a typology for modular service design. We review engineering, manufacturing, and service research literature and develop three key concepts for service modularization: service module, service architecture, and service experience. Thereafter these key concepts are further decomposed into detailed constructs. Basing on the reviewed literature, we develop a common typology for modular services. We argue that our typology provides a foundation for the development of modular service design methods. We also expect that it is important to recognize how customers perceive the service. We propose that service experiences can be characterized by value creation, role perception, personalization, and task complexity and by how the customers experience the particular services.

**Keywords:** Service modularization, module, architecture, process, experience, customer.

## 1 INTRODUCTION

Service oriented research has been conducted in various fields of research such as marketing, operations management, supply chain management, information systems science (Ostrom et al., 2010), industrial engineering, and service science. Vargo and Lusch (2004) have defined *services* as "*the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself*". According to Chesbrough and Spohrer (2006), services often are the key driver of growth and profitability. Thus, it is no surprise that organizations are increasingly developing new business models and service offerings that combine services to tangible products, i.e. servitizing their products (Williams, Chatterjee, & Rossi, 2008). Service modularization has been proposed as a way to accomplish this (Anu Bask, Lipponen, Rajahonka, & Tinnila, 2011; Böhmann, Junginger, & Krcmar, 2003; Pekkarinen & Ulkuniemi, 2008; Voss & Hsuan, 2009).

Modularity of services is a new and emerging research area, and worth to closer study as the importance of services is increasing. The modularization of services has been considered to serve three main purposes, any of which may justify expenditures to increase modularity (Baldwin and Clark, 2000): modularity makes complexity manageable; modularity enables parallel work and improvement; modularity creates adaptivity to deal with uncertainty. Based on Hyötyläinen and Möller (2007), modularity can also lead to decreased production costs. Furthermore, complexity can be decreased for example with cross use of modules between different services. Similarly, Pekkarinen and Ulkuniemi (2007) expect that better customer value and profitability can be achieved by standardizing the service production, i.e. by using a higher volume of common parts in several services. De Blok et al. (2010) expect that more effective customization is possible to achieve when using a modular set-up of service packages. In addition, in the service-oriented architecture (SOA) literature,

what is inside the modules is hidden, which means that the environment is only exposed to the service interface (Fremantle, Weerawarana, & Khalaf, 2002); the idea being that the elements within the module can be altered without affecting the interface. In this way it should be easy to replace the modules by using a variety of sourcing options (A. Bask, Lipponen, Rajahonka, & Tinnilä, 2011).

However, we argue that the challenges that modularization of services poses to service design have been unmet. The received view is that services should be designed as modular units and developed by mixing and matching these units to provide different combinations for meeting specific customer and market requirements, see, e.g., (Baines, Lightfoot, Benedettini, & Kay, 2009; Anu Bask et al., 2011; Tuure Tuunanen & Cassab, 2011). However, the literature does not provide clear guidelines for how to accomplish modular service design and development. In this paper, we seek to fill this gap in the literature and explore how services should be modularized for the purpose of service design activities. For this purpose, we propose a typology for modular service design.

The structure of the paper is as followed. First, we review the literature on modularization in order to develop a foundation for our typology. Then we continue by reviewing the literature on service modularity, modular service architecture and service processes. The outcome of the reviews is a typology for each of the areas. Finally, we discuss the implication of the work at hand for service design research and practice. Thereafter conclusions are drawn.

## 2 FOUNDATIONS FOR SERVICE MODULARIZATION

In this section we provide the foundation for service modularization by describing three important aspect of service modularity: service module, service architecture, and service experience.

### 2.1. Service Module

Based on Janssen (2008), the idea of service-oriented architecture is to develop a world of services that are loosely coupled and may be combined in a flexible way. The use of modularity offers the basis for customization. It yields economies of scale and scope for the service offerings (Voss & Hsuan, 2009). The modular service offering of an organization can consist of standardized base services, customized services, and their combinations. Hence, it is important to look at the interfaces, i.e. the connectivity of service components in the modular service offering. Voss and Hsuan (2009) define a service component as the smallest module (building block) in a service system. Characteristics of these modules include standardization, uniqueness, degree of coupling, and replicability. Standardized interfaces are a prerequisite for effective mixing-and matching of service modules and, thus, there is a need to define them precisely.

Based on Voss and Hsuan (2009), there are two options for service customization or composition. First, composition can be combinational, which means that a unique service is provided by combining a set of service modules (service processes and products). Second, composition can be menu driven, meaning that services can be selected from a set of existing service modules. Identification of service modules (decomposition) in a service system provides a basis for the effective composition of customer-specific configurations. Therefore, a systematic presentation of service

modules is needed to find out the full potential of service modularity (Böttcher and Klingner, 2011). A generic description for the service module construct is given in Table 1.

| Table 1. Definition of service module | | |
|---|---|---|
| Concept | Description | Reference(s) |
| Service Module | A service module is a system of components that offers a well-defined functionality via a precisely described interface and with which a modular service is composed, tailored, customized, and personalized. | (Anu Bask et al., 2011; Böttcher & Klingner, 2011; Janssen, 2008; Tuure Tuunanen & Cassab, 2011; Voss & Hsuan, 2009) |

## 2.2. Service Architecture

In service design and service innovations it is highly important to understand the nature of service architecture and modularity (Voss & Hsuan, 2009). Several authors, basing on a variety of theories and methods from different disciplines, have developed frameworks and tools for analyzing service architecture, see, e.g., (Böhmann et al., 2003; Hyötyläinen & Möller, 2007; Pekkarinen & Ulkuniemi, 2008; Voss & Hsuan, 2009). To summarize, some of the issues rising from the discussions are interfaces, boundaries, composition, standards, technologies (infrastructure), as well as shared and outsourced resources.

At a general level, modular service architecture enables the customization of a service offering and sharing (reuse) of service modules between different service offerings (Böhmann et al., 2003). Moreover, for service modules, the service architecture provides an integration framework where modules can be combined (Böhmann et al., 2003). This is in line with Voss and Hsuan's (2009) definition of service architecture: "*the way that the functionalities of the service system are decomposed into individual functional elements to provide the overall services delivered by the system. At each level of decomposition, the architecture can be either integral or modular*". Decomposition approach allows the systematic analysis of services (Geum, Kwak, & Park, 2012) and makes it possible to evaluate the current architecture, identify key interfaces, and evaluate alternatives for architectures (Voss & Hsuan, 2009). In the context of service architecture, several authors (A. Bask et al., 2011; Hyötyläinen & Möller, 2007; Voss & Hsuan, 2009) have discussed shared and outsourced resources, i.e. the division of labor. To summarize, the generic description for service architecture is provided in Table 2.

| Table 2. Definition of Service Architecture. | | |
|---|---|---|
| Concept | Description | Reference(s) |
| Service Architecture | Service architecture depicts the modular structure of the service, that is, (de)composition of the modules and their relationships, service interfaces, boundaries, as well as standards and technologies and shared or outsourced resource(s). | (Anu Bask, Lipponen, Rajahonka, & Tinnilä, 2010; A. Bask et al., 2011; Böhmann et al., 2003; Geum et al., 2012; Hyötyläinen & Möller, 2007; Voss & Hsuan, 2009) |

### 2.3. Service Experience

Customers are an important part of the service process. The literature says that the customers are active participants in service production, i.e. co-creators of the service (Vargo & Lusch, 2004). Grönroos (2008) has discussed this in-length and proposed that a service is an activity that has two perspectives to value creation; customer's and provider's co-creation activities. Tuunanen and Cassab (2011) have argued that the value of the service for the customer can be increased if service process modularization is utilized. Thus, they present that organizations can provide customized service packages of increased utility.

The challenge for organizations is to provide excellent service experience to customers in the front-end and at the same time deliver the service efficiently in the back-end (Zolnowski & Böhmann, 2011). When the level of customization increases in the service offerering, the share of service module modifications and original design modules increases simultaneously, which increases the personalization level of the service offering. Bask et al. (2011) suggest customization experience to measure customization in the customer service interface. Moreover, an active role in service customization is the input from both the customers and employees (Voss & Hsuan, 2009). Service providers need to incorporate personnel, processes or/and technical resources into service operations in the customer interface (Böhmann et al., 2003).

Table 3. Definition of Service Experience

| Concept | Description | Reference(s) |
|---|---|---|
| Service Experience | Service experience is an outcome of the firm meeting the users' needs through modularity-enabled customization, personalization, and value creation of the service. | (Anu Bask et al., 2011; Tuure Tuunanen & Cassab, 2011; Vargo & Lusch, 2004; Voss & Hsuan, 2009; Zolnowski & Böhmann, 2011) |

## 3 DEFINING SERVICE MODULE, ARCHITECTURE, AND EXPERIENCE

Next, we further describe the three key aspects of service modularization based on the reviewed literature: service module, service architecture, and service experience.. Each of the concepts is expanded into constructs of which they comprise. The concepts with their constructs are summarized in Tables 4-6.

### 3.1. Service Module

Next, we present a typology for the service module. It is comprised of communality, decomposition, reuse, substitution, and variation. This typology is summarized in Table 4.

Table 4. Service Module Constructs

| Concept | Description | Reference(s) |
|---|---|---|
| Commonality | A service module is common, variant or unique, the core modules providing communality and standardization, and the variants and unique modules variety and diversity to meet users' different service needs. | (Alizon, Shooter, & Simpson, 2009; Jiao, Ma, & Tseng, 2003; T. Tuunanen, Gardner, & Bastek, 2011) |

| | | |
|---|---|---|
| Decomposition | Divisions of information, processes, and services into modules (components, elements, units, nodes) that are independent of other modules, accomplish a certain function, and have an interface for integration. | (Baldwin & Clark, 2000; Böhmann et al., 2003; Böttcher & Klingner, 2011; Parnas, 1972; Voss & Hsuan, 2009) |
| Reuse | A service module can be reused as is or with minor revision in a different context in addition to the original context. | (Jiao et al., 2003; Mohan & Ramesh, 2003; Robertson & Ulrich, 1998; T. Tuunanen et al., 2011) |
| Substitution | A service module that is a part of a service system can be replaced with another module without changing or disrupting the service. | (A. Bask et al., 2011; Raddats, 2011; Voss & Hsuan, 2009; Wheelwright & Clark, 1995) |
| Variation | A new variant is developed from a service module by making a major revision or modification to the module's functionality and/or interface. | (Tuure Tuunanen & Cassab, 2011; van Ommering & Bosch, 2002) |

**Commonality** describes the grouping of similar module variants under a particular module type (Jiao et al., 2003). Hence, modularity, with its decomposed module types, describes a class of possible services. Specific services are created using the concept of variation. Service variants share the same module types but take on different instances, or occurrence, of every module type. Thus, service variants differentiate according to the commonality between module variants (T. Tuunanen et al., 2011). Thus, the service modules share elements for common functions. To assess commonality, numerous indices have been proposed in the literature. Nevertheless, the existing indices focus on commonality and reflect an increase in value when commonality increases, but do not positively reflect an increase in value as a result of diversity (Alizon et al., 2009). Common functions are the same for all services, variant functions are the same but the attributes are different, and unique functions are specific to an individual product. According to Alizon et al. (2009), common functionality should use common components, unique functions should use unique components, and variant functions should use variant components in the same proportion.

Furthermore, a service can be decomposed into service modules that have a distinct role and are independent from other modules, i.e. they are loosely coupled (Baldwin & Clark, 2000; Böhmann et al., 2003). Further dividing may continue **decomposition** of the modules, ending up to a hierarchical modular structure, see, e.g., (Böttcher and Klingner, 2011). Within this structure, the lower level modules do not make use of the higher-level modules (Parnas, 1972). The conventional decomposition based on tasks and activities or timing is often insufficient to capture the benefits of modularization such as shorter development time, flexibility, and comprehensibility of both a single module and the whole system (Parnas, 1972). Voss and Hsuan (2009) maintain that decomposing means division of functionalities of the service system into individual

functional elements. Strong interdependencies within modules may require their further decomposition (Baldwin & Clark, 2000; Böhmann et al., 2003).

The concepts of **reuse and variation**, in turn, draw heavily upon the concepts of commonality and decomposition (Jiao et al., 2003). Modularity aims to decompose a service into independent module types, where a module type is a grouping of components that share some characteristics. Commonality, in turn, describes the grouping of similar module variants under a particular module type. Thus, modularity, with its decomposed module types, describes a class of possible services. Specific services can then be created using the concept of variation. Service variants share the same module types, but take on different instances of every module type (T. Tuunanen et al., 2011). When utilising a reuse concept, a trade-off exists between the aspects of commonality and distinctiveness (Robertson & Ulrich, 1998). Modules are only customisable to a certain degree without violating the reuse-focused core of the development approach (van Ommering & Bosch, 2002). Therefore, the solution for addressing the products' distinctiveness is to introduce a sufficient number of variation points to the assets (Mohan & Ramesh, 2003). Variation points can be used to fine-tune assets when instantiating them into a service. They typically control an asset's internals, the presence or absence of certain assets, or the binding between assets (van Ommering & Bosch, 2002).

Finally, Wheelwright and Clark (1995) recommend specifying platform-based products that are able to satisfy the needs of the core group of customers and easily create derivatives through the addition, substitution, and removal of features. We build on this recommendation and argue that a service module that is a part of a service system can be **substituted** with another module without changing or disrupting the service or end product. In products, mass customization can be accomplished by increasing the substitutability factor (Voss & Hsuan, 2009). Modularization thus makes it possible to integrate and disintegrate potential new service components efficiently and effectively, either by sharing modular components internally or by outsourcing modular components to an external supplier (A. Bask et al., 2011; Raddats, 2011; Voss & Hsuan, 2009). The challenge is in defining services in a form that permits the maximization of their reuse (High, Krishnan, & Sanchez, 2008).

### 3.2. Service Architecture

In the following, we present a typology for the service architecture. It is comprised of service boundary, composition, interface, standard, infrastructure, and shared and outsourced resources. This typology is summarized in Table 5.

Table 5. Service Architecture Constructs.

| Concept | Description | Reference(s) |
|---|---|---|
| Boundary | A detailed description of the scope and contracts what comprise the service module within the service architecture and externally with customers and other actors. | (Böhmann et al., 2003) |

| | | |
|---|---|---|
| Composition | Composition(s) of the service offering(s) based on customization of service components, parts or processes. | (Anu Bask et al., 2011; Hyötyläinen & Möller, 2007; Raddats, 2011; Tuure Tuunanen & Cassab, 2011) |
| Interface | Interfaces define how service modules interact with and connect to each other. | (Böhmann et al., 2003; Hyötyläinen & Möller, 2007) |
| Standard | Standards define the rules for organizing internal and external resources in a structured way. | (Geum et al., 2012; Pekkarinen & Ulkuniemi, 2008) |
| Infrastructure | The required technical infrastructure that enables the service provision, such as back office technical setup, server computers, and software. | (Joachim, 2011; Mayerl, Vogel, & Abeck, 2005; T. Tuunanen et al., 2011) |
| Shared and Outsourced Resource(s) | The division of labor and outsourcing of tasks across firms and supply chain variations by sharing modules internally or by outsourcing modules to an external supplier. | (Anu Bask et al., 2011; Janssen, 2008; Janssen & Joha, 2008; Schilling & Steensma, 2001; Voss & Hsuan, 2009) |

In terms of architecture, the **boundaries** between specific service modules are important. Boundaries define individual service modules in relation to other service modules within a particular service architecture, but also the external boundaries of the module (Böhmann et al., 2003). The external boundaries provide a detailed description of the scope of service. In addition, the boundary information details how the relationships between internal and external service modules are governed. This governing definition forms a boundary contract between modules (Böhmann et al., 2003). Similarly, modularity can be seen as a means to standardize service production and, thus, achieve better customer value and profitability (Pekkarinen & Ulkuniemi, 2008). **Standards** therefore form rules for organizing internal and external resources, i.e. service modules. In the SOA literature, standards are often linked to the governance structures of service modules and the organization (see, e.g., Joachim, 2011).

According to Bask et al. (2011), the **composition** of service modules is closely related to the customization of service modules. They have approached the issue by linking it to mass-customization and the degree of customization for specific service offerings and modules. Raddats (2011), in turn, discusses how service functionalities are decomposed into service components. Bask et al. (2010) further describe a service offering as a modular system packaged together from service elements. Hyötyläinen and Möller (2007) have argued that the service elements for functionalities should be as common as possible within an individual service module. Tuunanen and Cassab (2011) have taken a service process based view. They define a service module as the systematic combination of service processes known to both the customer and the firm that generates new, customizable service packages. Tuunanen and Cassab (2011) characterize these service packages as service extensions using the concepts of base service (non-customized) and customized service extensions that are based on either the reuse or variation of service processes.

The service **interfaces** specify how service components and modules interact between each others (Raddats, 2011). Janssen and Joha (2008) have depicted this interaction in the SOA literature, where technical service modules are limiting all communication with other service modules to specific service interfaces. These service interfaces act as gates to the service module and provide its connections to other service modules. Moreover, the inside operations of a service module are hidden from other service modules and the interface limits their access. Böhmann et al. (2003) have similarly emphasized the need for forming standardized interfaces between service modules to enable the information flow. Hyötyläinen and Möller (2007) have presented that service blueprinting (Bitner, Ostrom, & Morgan, 2008) is very useful for depicting how interfaces function and how and what kind of information they transfer between service modules and service providers. Hyötyläinen and Möller (2007) especially refer to guidelines, tools, and methods that enable service interfaces.

According to Alter (2008), all services are produced through service systems, which he defines as work systems where human participants or machines perform work using information, technology, and other resources to produce services. The **infrastructure** describes both technical and non-technical requirements that need to be met for the provision of the service (T. Tuunanen et al., 2011). This can be e.g. the last-mile broadband Internet speed offered for the customer or the backbone network capacity of the Internet operator that hosts a specific service. Therefore, the infrastructure also consists the information system (e.g. software, server computers, networks) enabling the provision of the service (Hyötyläinen & Möller, 2007; T. Tuunanen et al., 2011). The user interface (UI) that is responsible for the communication between the user and the service offering, i.e. for every computerized and non- computerized aspect of interaction, should be specified as well (T. Tuunanen et al., 2011). The details of the technical specifications of SOAs have been widely discussed in the literature (Joachim, 2011; Mayerl et al., 2005).

Finally, according to the literature, service architecture should comprise a definition of **shared and outsourced resources** and of how the division of labor is done. The management of the outsourcing of tasks across firms and supply chain variations must be defined. This issue closely relates to the modularity of organization and supply chains, see e.g. (Anu Bask et al., 2010; Schilling & Steensma, 2001; Voss & Hsuan, 2009). The organizations of firms are becoming increasingly modular due to the outsourcing of functions and the use of service modules that lie outside the firm, making the entire production system increasingly modular (Schilling & Steensma, 2001). This can even lead to modular structures at the industry level by sharing service modules internally or by outsourcing service modules to an external supplier (Janssen, 2008; Janssen & Joha, 2008; Voss & Hsuan, 2009).

### 3.3. Service Experience

Finally, the service experience concept is further decomposed to four process-related constructs: customer's role perception, personalization, task complexity, and value creation. These are summarized in Table 6.

Table 6. Service Experience constructs.

| **Concept** | **Description** | **Reference(s)** |
|---|---|---|
| Personalization | Personalization through new | (Alizon et al., 2009; |

| | | |
|---|---|---|
| | combinations of service modules enables the customization of the service to reflect user's real or wished preferences, values, and personality. | Anu Bask et al., 2010; T Tuunanen, Peffers, Gengler, Hui, & Virtanen, 2006; Voss & Hsuan, 2009) |
| Role Perception | The perceived utility of the modular service depends on customer's role clarity, the specific characteristics of the service, and the outcomes they expect to achieve. | (Cook et al., 2002; Michel, Brown, & Gallan, 2008; Tuure Tuunanen & Cassab, 2011; Xue & Harker, 2002) |
| Task Complexity | A service process can be characterized by low or high level of task variety, technical skills required, and information exchange between the service system and the customer. | (Tuure Tuunanen & Cassab, 2011; Wemmerlöv, 1990) |
| Value Creation | The systematic combination of service encounter processes known to both the customer and the firm that creates new, customizable service packages of increased utility. | (Grönroos, 2008; T. Tuunanen et al., 2011; T Tuunanen, Myers, & Cassab, 2010; Vargo & Lusch, 2004) |

Tuunanen et al. (2011; 2010) have defined service process modularization as the systematic combination of service encounter processes known to both the customer and the firm that generates new, customizable service packages of increased utility. This view builds on the service dominant logic (Vargo & Lusch, 2004) that means a change from providing services of pre-determined value to a new landscape where firms only provide value propositions, and thus focusing on to the logic of **value creation** (Grönroos, 2008). Thus, both the customer and the firm determine the total value of the service in use. More specifically, a service is an event in time and space where a service encounter materializes (Bitner, Brown, & Meuter, 2000). Such a transaction will occur when the customer's perceived view of utility, ease-of-use, and simplicity have been satisfied. Furthermore, the literature proposes that value creation is something that takes place between a service provider and a customer (Grönroos, 2008; Vargo & Lusch, 2004).

Michel et al. (2008) have argued that the customer's role is a key influencer for service innovations. Tuunanen and Cassab (2011), in turn, have proposed that the customer's **role perception** is related factors such as clarity, motivation, and ability. Thus, according to them these are key factors that influence the trial decision of service delivery systems that rely on the customer for the service production. Furthermore, customer's efficiency influences the quality of the service process (Xue & Harker, 2002). Therefore, customer efficiency should increase by taking advantage of a familiar service process (Cook et al., 2002). Tuunanen and Cassab (2011) have claimed that the customers with higher role clarity are expected to be more willing to try new service propositions, given their experience and tolerance for variety. Customers with lower role clarity, however, need to be convinced of the fact that learning a variation of the known service process is worth their effort, especially

when the new service process involves active participation in the production of the service.

Service process modularity has been defined as the usage of reusable process steps that can be "mixed and matched", or **personalized**, in service implementation to accomplish flexibility and customization for different customers or situations (Anu Bask et al., 2010; Voss & Hsuan, 2009). Mayerl et al. (2005) have proposed that there can be a set of common processes and sets of processes for individual services. Tuunanen et al. (2006), in turn, have argued that the customer's service preferences are influenced by the values they possess. If we combine the views of Meyer et al. (2009) and Tuunanen et al. (2006), we can present value based personalization of the service preferences so that the service reflects user's real or wished personality and allows combinations (mix-and-match) that are wished for.

According to Wemmerlöv's classification (1990), service processes can be characterized by **task complexity**. The level of task variety, the level of technical skills required, and the level of information exchange between the service system and the customer define task complexity of the service process experience. A high task complexity service experience increases not only the cognitive load but also the psychological risk and the search costs of the customer. This is particularly evident with customers who are less knowledgeable about the service process. Tuunanen and Cassab (2011) argue that reusing a service process in a new service offering reduces customer anxiety associated with learning a new routine. Alternatively, modular variation in a service of high task complexity would increase the cognitive load and, thus, the level of challenge for the customer.

## 4 IMPLICATIONS FOR RESEARCH AND PRACTICE

This paper proposes a typology for modular service design (Table 7). Based on the literature review on modularization and services, three key concepts of service modularization emerged: service module, service architecture, and service experience. These concepts follow the ideal of modularization and are building on each other. That is, service modules comprise service architecture, which in turn constitute the basis for service experiences (from the process viewpoint). We have further decomposed these key service modularization concepts to more specific constructs that could be used as the basis for modular service design.

Table 7. Modular Service Design Typology.

| **Service Module** | **Service Architecture** | **Service Experience** |
|---|---|---|
| Commonality | Boundary | Personalization |
| Decomposition | Composition | Role Perception |
| Reuse | Interface | Task Complexity |
| Substitution | Standard | Value Creation |
| Variation | Infrastructure | |
| | Shared and Outsourced Resource(s) | |

Our paper contributes to the service modularity literature in several ways. First, to our knowledge, it presents, the first typology for modular service design. We first draw from the engineering, manufacturing and service science literature to develop the basic definitions of service modularization. Thereafter, we look at the SOA literature and studies more related to IT-enabled services, see, e.g., (Böhmann et al., 2003; Voss & Hsuan, 2009) to describe our perception of what constitutes a service architecture. Finally, with the service experience layer we integrate service modularization and architecture constructs in service research about the process nature of services (Michel et al., 2008; Tuure Tuunanen & Cassab, 2011; Vargo & Lusch, 2004; Wemmerlöv, 1990), (service research has its roots in marketing science).

Secondly, the typology provides a common ontology for service modularization that can be used for developing modular service design methods. The current service design methods, such as service blueprinting (Bitner et al., 2008) or Böttcher and Klinger's (2011) method for composing modular services, often focus on a specific aspect of the service design. In the case of service blueprinting, the method excels for understanding customer's perspective to the service process. The service is presented as service encounters, or events, that are interlinked with the service process. Böttcher and Klinger (2011), in turn, look at service compositions and provide ways to visualize the service configuration process. However, there are little, if any, service design methods that would take a more holistic view to service design. This is perhaps an outcome of the fact that there has not been a typology to build on to develop such a method. We argue that our typology provides such a foundation for modular service design method research.

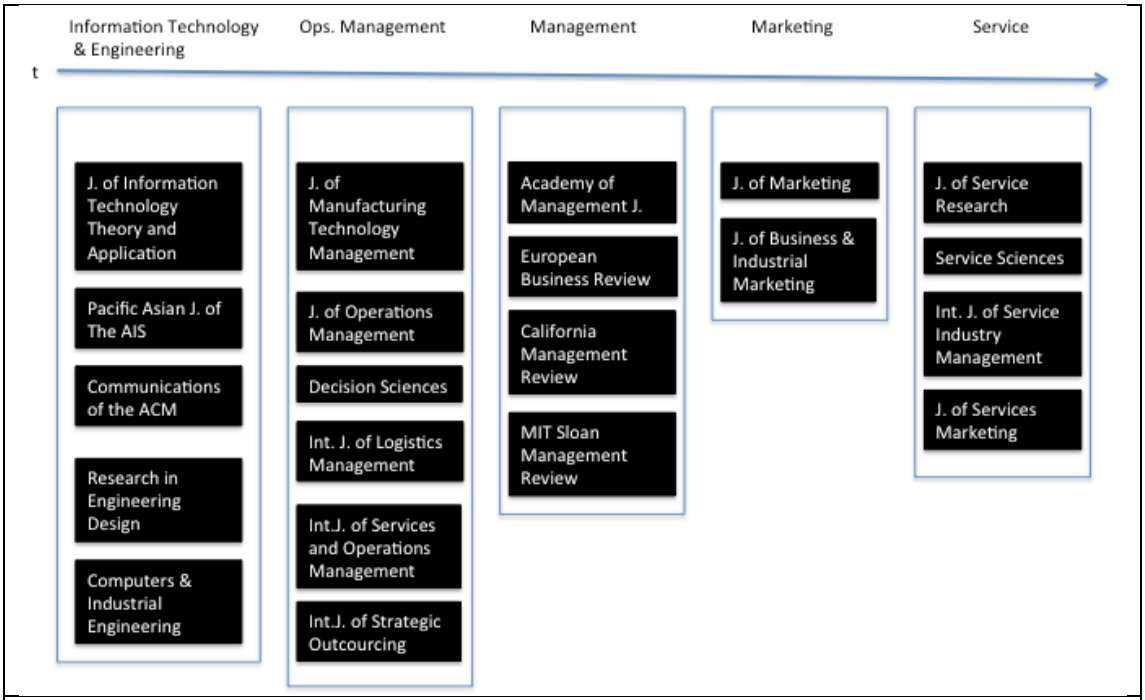


Figure 1. The spectrum of contributing disciplines and journals to modular service design

Thirdly, if we take a look at the spectrum of contributing disciplines and journals (Figure 1) we can see that the literature basis for our modular service design incorporates research from information technology and engineering, operations

management, management, marketing, and service research. From Tables 4-6 we can find that the roots of modularity are emerging from engineering and information technology literature. This is reflected well in Table 4, which summarizes the modular service concepts. Regarding the service architecture, a majority of the literature has been published in operations management journals. Finally, when taking a look at the service experience constructs we notice that the emphasis shifts towards marketing and service research journal outlets. This implies two issues. First, there is a discipline building up around service research with its own journals and research community, but also when investigating service experience related matters the prior research in marketing science should be recognized including the extensive work in understanding consumer behavior etc.

For practitioners, our work is important in terms of understanding how service modules can be defined, and, even more importantly, how they constitute the architecture for modular services. Our service architecture, and constructs defining it, provides the conceptual tools for developing modular service design methods and specifying a wide-ranging view to firm's service offering from both customers' and organization's viewpoint. Furthermore, it is recognized that it is very difficult to provide an excellent service experience to customers (Zolnowski & Böhmann, 2011). Our typology also enables practitioners to take a service experience perspective to their modular service offering.

## 5 LIMITATIONS AND FUTURE RESEARCH

Our paper presents a synthesis of the modularization literature. Although the review is extensive, it is not meant to be comprehensive by nature. Our objective was to review engineering, manufacturing, and service research literature to develop a typology for modular service design. Our purpose was not to conduct an all-inclusive structured review of service modularization. Therefore, we acknowledge that our review does not offer a complete view to service modularization as we did not aim to a systematic literature review, see e.g., (Tranfield, Denyer, & Smart, 2003), or a keyword word based structured review, see, e.g. (Mathiassen, Saarinen, Tuunanen, & Rossi, 2007). This decision was done, as the literature on service modularity is rather scarce.

The typology for modular service design (Table 7) offers conceptual tools to both academics and practitioners for taking a holistic view to service modularization from the service design point of view. However, our paper does not provide a modular service design method that could be used for service design. We argue that for developing such a method, we first need to understand what a modular service is about and of which elements it is comprised. Also, there is a further need to comprehend the overall value creation process for the customers, and also for the firm's staff, during the service experience. We expect that our typology provides a foundation for this work. Thus, it provides a starting point for other researchers to develop modular service design methods that address these needs and ways to increase better understanding of the service experience.

Furthermore, although our typology offers concepts for a service module, a service architecture and service experience the literature does not offer examples of applying the concepts. For the application of our typology, we expect that researchers from their specific disciplinary backgrounds are able contribute different ways. For example, information technology and engineering researchers can most likely

advance our understanding of modularization of a service beyond the focus of the service process (Tuure Tuunanen & Cassab, 2011). Another interesting perspective is how the service architecture is currently conceptualized in the literature. Voss and Hsuan (2009) have provided the basis for this work. However, their work does not provide clear guidelines how to use the service architecture concepts in design of new services. Here information technology and engineering researchers may be able to assist, see, e.g., the work by Böhmann et al. (2003) on modular service architectures for engineering information technology services.

Finally, we acknowledge that our typology is conceptual as it is based on the conducted literature review only. The typology should be validated by field studies. Case studies with service industry would be highly interesting for this purpose. They would probably lead to the refinement and/or extension of the presented typology. An alternative approach would be to do interviews, focus group discussions (Krueger & Casey, 2000) or a Delphi study (Linstone & Turoff, 1975) to elicit expert opinions and knowledge on modular service design. Action research, see, e.g., (Susman & Evered, 1978) with service industry would also be intriguing. However, these studies would most likely be more beneficial to the service design method development than for the refinement of the typology.

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