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Modularization in business service innovations

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Abstract: We argue that four service innovation mechanisms by Gallouj and Weinstein imply that services are modular offerings. In this comparative case study, we look at four knowledge-intensive business service innovations to further understand the nature of modularization in services. Our findings indicate that modularization was used primarily for systematization and innovation purposes, and the preferred way of customization was tailoring. A broad range of modularity types can be found in services, and modules are typically fitted. We evaluate the usefulness of the existing typologies for services, and find them important but too straightforward for services as such, and difficult to implement due to inseparability and intangibility characteristics.

Keywords: Modularization; modularity; services; innovation; knowledge-intensive business services; professional services; service innovation; customization.

1 Introduction

In their often-cited article, Gallouj and Weinstein [10] propose, among others, four mechanisms of innovation in services which imply a view of services as modular offerings. All four mechanisms – improvement of individual service elements, addition of new or replacing old elements, combination of elements from several existing services or division of existing services, and development of the value proposition – have been found in our comparative case studies on innovation in knowledge-intensive business services (KIBS), out of which we have already reported general findings [2,3,27,28]. Now we concentrate on the issue of modularity in the context of service innovations. We use the typology by Ulrich and Tung [29] to analyse the modularity aspect in service innovations. Customization typologies provide further insight on the nature of modularization for customization in KIBS.
2 Theoretical background

Services and innovation

We first clarify what we mean by ‘services’. Typical service definitions (see [12] for a review) view services as performance/activity offered for exchange. Brax [4] interprets this that services can be understood as process offerings. With physical goods, the production process and its output can be separated and the detached output is the core value proposition. In services the process itself is offered to client. It may produce tangible outputs and/or intangible benefits as its output, but the service process is the core of the value proposition; e.g. ‘safety’ might be marketed to clients, but this benefit cannot be realized without service activities ensuring the conditions of safety. Furthermore, in addition to outcome benefits, customer benefit may reside embedded in their service provision/consumption process (e.g. recreational services). [4] Building on Edvardsson’s [7,8,2] work, we perceive three dimensions in a service offering: service concept, resources and process. Brax [2] conceptualizes services as systemic phenomena, as changes in one dimension affect other dimensions. Service design is about orchestrating the dimensions into one balanced entity.

In our study, we focus on business-to-business services, i.e. services provided by one organization to another organization. KIBS are their knowledge intensive subcategory. Knowledge intensity means that the service provider and the client jointly create new knowledge [26] – which is often reflected at the value proposition of the service. This is different from the traditional concept of professional services, in which the customer may have a more passive role and the professional know-how is implemented by the provider to solve clients’ problems. This way of defining KIBS suggests that the offering continually changes, in terms of the three-dimensional system view explained above, due to knowledge creation [2]. Nevertheless, professional services and KIBS are close terms and the categories overlap.

In literature the term ‘innovation’ refers to both innovations as outcomes and the processes of producing them, other perspectives are the target of innovation, the radicalness of the renewal, and the nature of the innovation [13]. We use the definition of service innovations-as-outcomes synthesized by Toivonen and Tuominen [27]:

“A service innovation is a new service or such a renewal of an existing service which is put into practice and which provides benefit to the organization that has developed it; the benefit usually derives from the added value that the renewal provides to the customers. In addition, to be an innovation the renewal must be new not only to its developer, but in a broader context, and it must involve some element that can be repeated in new situations, i.e. it must show some generalizable feature(s). A service innovation process is the process through which the renewals described are achieved.” [27]

Thus, innovation is not merely a tailored offering, and services new to the firm but not to the market are not innovations. Innovation is different from idea in that it has been put to practice. Innovation may concern any or all of the system dimensions of a service: the service concept including outcomes, resources, or the service process. This connects the service innovation to the concepts of product innovation, new technology, process innovation and organizational innovation.
Gallouj and Weinstein [10] identify several ways in which innovations can be created in services. Individual elements can be improved, new elements added or existing ones replaced with new. Elements from existing services can be bundled or unbundled to create new services. The way in which different elements of a service provide benefit to the client can be clarified. Gallouj and Weinstein call these four types: improvement innovation, innovation by addition or substitution, recombinative/architectural innovation, and formalization innovation.

**Modularization**

According to Baldwin and Clark [1,p.86],

“Modularity is a strategy for organizing complex products and processes efficiently. A modular system is composed of units (or modules) that are designed independently but still function as an integrated whole.”

Modularization theory has developed together with mass-customization theory in the context of manufacturing. Modularization commonly points to product architecture required for mass-customization. Literatures of modularity in services and assembled goods have remained disconnected (except [22]).

Mintzberg [19 cited in 6,16] categorized customization in three types. In pure customization the product is designed and produced from start for each customer, involving the customer throughout the production. In tailored customization a basic design is altered to fit specific customer needs, involving the customer from later stages. In standardized customization the product is assembled from a predetermined set of standard components, allowing the customer to select the features from a list. [19 cited in 6]. Pure customization is most flexible but also expensive, whereas standardized customization permits a broad range of feature combinations in the context of mass production. Another typology by Gilmore and Pine [11] encompasses four ways of customization. In adaptive customization one standard product is designed so that clients can alter it themselves. Cosmetic customization means presenting standard products differently for different clients. Transparent customization provides unique offerings to clients without client awareness of customization. In collaborative customization the client and the provider determine the product characteristics together. [11] While mass-customization requires modular product architectures [6,22], customization, as such, does not.

Customization of goods can take place in different stages of the production cycle – during design, production, assembly and use [6]. In services all these may happen simultaneously being tightly coupled in a service exchange. Pure services do not include assembly. Furthermore, customers’ participation in the service is another possible source of customization.

Peters and Saidin [22] analysed how services adapt to mass-customization through modularization. The variability/heterogeneity characteristic makes increasing variability easy, while intangibility eases changing service modules. In ongoing services, learning along the service relationship typically occurs, enabling further adjusting to customer needs. [22] Similarly, Baldwin and Clark [1] recognize the advantages of intangibility:

“Nothing is easier to modularize than stocks and other securities... Because the science of finance is sophisticated and highly developed, these services are relatively easy to define, analyze, and split apart.”
Sundbo [24,p.245] perceives “modulization” as creating services “out of standard elements – modules – that can be combined for the individual customer at the moment of purchase.” The classification by Ulrich and Tung [29] identifies six different kinds of modularity, and we therefore use it as our starting point. Table 1 below explains the different modularity.

Table 1 Modularity categorization by Ulrich and Tung

<table>
<thead>
<tr>
<th>Modularity type</th>
<th>Description</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component sharing</td>
<td>Common components used in the design of a product. Products are uniquely designed around a base unit of common components.</td>
<td><img src="image1" alt="Illustration" /></td>
</tr>
<tr>
<td>Component swapping</td>
<td>Ability to switch options on a standard product. Modules are selected from a list of options to be added to a base product.</td>
<td><img src="image2" alt="Illustration" /></td>
</tr>
<tr>
<td>Mix modularity</td>
<td>Similar to component swapping, but it is distinguished by the fact that when combined, the modules lose their unique identity.</td>
<td><img src="image3" alt="Illustration" /></td>
</tr>
<tr>
<td>Sectional modularity</td>
<td>Also similar to component swapping, but focuses on arranging standard modules in a unique pattern.</td>
<td><img src="image4" alt="Illustration" /></td>
</tr>
<tr>
<td>Cut-to-Fit modularity</td>
<td>Alters the dimensions of a module before combining it with other modules. Used where products have unique dimensions such as length, width, or length.</td>
<td><img src="image5" alt="Illustration" /></td>
</tr>
<tr>
<td>Bus modularity</td>
<td>Ability to add a module to an existing series, when one or more modules are added to an existing base.</td>
<td><img src="image6" alt="Illustration" /></td>
</tr>
</tbody>
</table>

Source: [29] cited in [6,p.609], reconstructed.

Pahl and Beitz [21] categorize modules as follows: Basic modules implement the product’s basic functions, being fundamental and invariable. Auxiliary modules are used with them to add auxiliary functions. Adaptive modules adapt the part/system to other parts/systems. Nonmodules are individually designed customer specific functions. [12 cited in 15] This categorization has some correspondence with the idea of augmented service offering [12], which suggests that service offerings are bundles of components. An augmented service offering consist of a core service that fulfills the customers need in question, facilitating services that are necessary in delivering the core service, and supporting or augmenting services that add value to the core [12].

A key issue concerning modularity is how the different levels are defined; what is an offering, a module, a component – i.e. what are the relationships between entities and their parts. Mikkola and Skjøtt-Larsen [17] perceive four levels of modularity: the component level, the module level, the sub-system level, and the system level. The
component level offers the broadest opportunities for modularization, whereas the possibilities are smaller in the modular level, smallest in the sub-system level, and none in the system level. [17] Peters and Saidin [22] report a three-level modular structure in services based on symbols from chemistry: the smallest parts of a service were called ‘atoms’, and ‘elements’ were sub-offerings created from atoms to be combined into ‘molecules’, the service solutions for customers. Molecules sometimes became the buses to which the other elements or molecules could log into. Atoms were the parts of the process, elements were logical bundles of tasks that should not have broken but neither were complete service offerings as such.

Duray [5,6] distinguishes four ‘operationalized configurational models’ for customization based on the point of customer involvement in the production process and type of modularity (see Figure 1). Fabricators resemble traditional customizers who tailor-make their products and employ craft techniques, but they use modularity as an instrument to achieve the customized output. Fabricators and involvers engage customers early in design and fabrication, but fabricators utilize modularity in design and fabrication, whereas involvers use modularity in assembly and use, perhaps offering more of an image of than a truly customized product. Modularizers utilize modularity in the design and fabrication stages, but involve customer in assembly and delivery. Assemblers use modularity and involve customers in assembly and use or delivery phases. Their production technology is close to standard production and customization is done through predetermined sets of components. [5,p.317-318]

![Figure 1 Typology of operational options for modular customization by Duray et al.](image)

Wide-spread adoption of modularity has increased the rate of innovation in some industries. This is because different modules can be developed simultaneously by different teams that follow shared design rules to ensure component compatibility, and because new offerings can be constructed by changing certain modules instead of designing the offering from the beginning. [1,10]

### 3 Method

The modularization and customization typologies discussed above focus on manufacturing and hence their applicability to services is unclear. In the following analysis we look at KIBS innovations based on these typologies. Our intentions are:

- to test how these typologies can be applied in the services context;
• to find out how they can help us better understand service innovations and service modularity as well as the role that modularity plays in innovative services, and;
• to identify needs to develop the modularity theory further in the services context.

In this paper we analyze four cases of service innovations in four Finnish KIBS firms. We regard KIBS as ideal cases for our analysis due that several researchers have argued that KIBS firms are important carriers, facilitators and sources of innovations [9,14,18]. The services examined were selected in a preliminary interview of the company management. They were considered as innovations due that no similar services existed in their market.

The main method used in the data collection was semi-structured face-to-face interviewing. Regarding each service, 2-3 persons who had been involved in its development were interviewed during 2005 and 2006; the persons represented different management levels. Primary documents, memoranda of company workshops and preliminary management group interviews were used as additional data. In the analysis phase, using a basic content analysis technique, clues of modularity and innovation were sought in the data, and cases were categorized accordingly as representing different types explained in the theoretical background.

4 Analysis and findings

We first introduce the studied cases and then continue with a more detailed comparative analysis. We focus on the use of modularization, approach on customization, and operational approach to conduct customization. We then evaluate the role of modularity against the perceived service innovation. The companies and selected cases represent different KIBS sectors.

The engineering consultancy company had developed a web-based service that enabled holistic follow-up and optimization of the clients’ building services systems operations (heating/cooling, water supply, etc.) including consultancy and tools for further analyses. Existing control programs were stand-alone systems: the new service added value through integrating the data, enabling a holistic approach to building services management and opening new possibilities for consulting clients in optimizing their building services, including regular analyses and improvement plans.

The architectural design company had developed a workplace design service in which office layouts are planned to support the client’s business strategy more effectively. The company recognized that all office work is not similar, and that offices need to be designed as much as manufacturing plants. This service changed the architects’ role and work completely. They enter the client’s planning process earlier and emphasize consultancy, and the services may not involve construction projects – or even drawing – at all.

The advertising agency renewed the traditional marketing communications services by adding innovative elements in the offering and a strategic perspective to its services. The company takes the idea of integrated marketing communications and brand building as its guiding principle. Advertising campaigns are viewed and designed as tools to strengthen or redefine the client’s brand. The company offers management consulting services to help the client clarify its marketing strategy and brands based on its business strategy. The redefined value proposition to client shifted the value offering point upstream, making the firm client’s partner in marketing management.
The accounting company had created a *purchase price allocation and goodwill impairment testing service* in the context of acquisitions. These services are based on new international regulations which include detailed valuation of immaterial property.

Each case was categorized in terms of the categorization structure extracted from the literature as presented in Table 2 that also summarizes the results. Information regarding the analyzed themes within a case, provided by different respondents, was consistent.

**Table 2** Modularization in case examples – results

<table>
<thead>
<tr>
<th>Focus of analysis</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Engineering consultancy – building service systems optimization</strong></td>
</tr>
<tr>
<td>Mechanism of innovation</td>
<td>Addition of new elements, improvement, extended value proposition</td>
</tr>
<tr>
<td>Type of customization (pure, tailored, standardized; adaptive, cosmetic, transparent, collaborative)</td>
<td>Standardized, transparent</td>
</tr>
<tr>
<td>Types of modularity and modules (component sharing; component swapping; mix, sectional, cut-to-fit, bus)</td>
<td>Bus, cut-to-fit; basic (auxiliary ?)</td>
</tr>
<tr>
<td>Operational approach (fabricator, involver, modularizer, assembler)</td>
<td>Design, production and/or use overlap; several types of customization implemented simultaneously; → typology not valid</td>
</tr>
<tr>
<td></td>
<td><strong>Architectural service – workplace design</strong></td>
</tr>
<tr>
<td>Mechanism of innovation</td>
<td>Addition of new elements, new value proposition</td>
</tr>
<tr>
<td>Type of customization (pure, tailored, standardized; adaptive, cosmetic, transparent, collaborative)</td>
<td>Tailored, collaborative</td>
</tr>
<tr>
<td>Types of modularity and modules (component sharing; component swapping; mix, sectional, cut-to-fit, bus)</td>
<td>Sectional/bus, cut-to-fit, component sharing; basic, adaptive (auxiliary, non-module ?)</td>
</tr>
<tr>
<td>Operational approach (fabricator, involver, modularizer, assembler)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Advertising – integrated marketing communications</strong></td>
</tr>
<tr>
<td>Mechanism of innovation</td>
<td>Recombination, improvement, extended value proposition</td>
</tr>
<tr>
<td>Type of customization (pure, tailored, standardized; adaptive, cosmetic, transparent, collaborative)</td>
<td>Pure, tailored, collaborative</td>
</tr>
<tr>
<td>Types of modularity and modules (component sharing; component swapping; mix, sectional, cut-to-fit, bus)</td>
<td>All; basic, non-module, auxiliary</td>
</tr>
<tr>
<td>Operational approach (fabricator, involver, modularizer, assembler)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Accounting – purchase price allocation and goodwill impairment testing</strong></td>
</tr>
<tr>
<td>Mechanism of innovation</td>
<td>Addition of new elements, new value proposition</td>
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<tr>
<td>Type of customization (pure, tailored, standardized; adaptive, cosmetic, transparent, collaborative)</td>
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<td>Sectional, cut-to-fit; basic</td>
</tr>
<tr>
<td>Operational approach (fabricator, involver, modularizer, assembler)</td>
<td></td>
</tr>
</tbody>
</table>

The type of customization varied between the cases. The engineering and accounting services used a standardized form, the former due to its technology and the latter due to the strict framework of accounting laws. Both were viewed as relatively transparent. The engineering firm offered different service levels to choose from without emphasizing modularity. The accounting firm similarly offered its service as a subproject taking care of the tasks in the client’s merger or acquisition process.

The architectural firm and the advertising agency implemented “collaborative tailoring” as customization strategy. They either tailored or developed new services and
involved the client in the design phase. Client involvement often had the additional, instrumental roles of preparing the client for change and arousing interest in collaboration in a deeper, strategic level.

*Types of modularity* also varied. The engineering consultancy offering represents bus modularity, due that all versions of the service were based on the system; modules were attached to extend the service level. Interestingly, the linkages between the clients’ building services systems and the service system can be understood as bus modularity too: each customer’s building services system represents a single module attached to the base.

Architectural service could be viewed as sectional or bus modularity; the structure was sectional in the sense that the process was divided to ‘blocks’, however these had a sequential order that could be understood as being the base product required in bus modularity, although the modules were predetermined cut-to-fit types. Component sharing occurred when the company detached parts developed as modules for the workplace design service and launched a new service that utilized them – this goes beyond the design service case but was reported in the data as a ‘spin-off’ from the original service innovation. The modular structure was used for organizing work rather than customizing, and each module (e.g. analysis) had a functional role in delivering the overall value proposition of the offering. Some modules were designed to affect the client; these could be understood as being a hybrid of adaptive and basic modules.

The advertising agency used flexibly all means of modularization. It recycled modules or components, tailored or developed from scratch, by swapping and sharing or constructing new combinations (sectional modularity). It also used some modules within broader offerings mixing them to the integrated service exchange. The process of developing integrated marketing communications approach for a client might be regarded as a product base that allows bus modularity but modules were also offered detached. In these cases the firm typically mixed elements of the broader offering to narrower offerings, for instance promotional campaigns were based on a conceptualization of the firm’s brand strategy.

The accounting service was clearly sectional modularity. The modules were purchase price allocation and goodwill impairment testing. The customer could have one module separately or both. Modules were divided into components which were tasks in the basic process, such as identifying different types of assets and valuating them.

Cut-to-fit modularity was prevalent in all cases: modules were scaled and adjusted to specific customer requirements. The main reason was that the service activities focused on clients and clients were different. The scope of fitting varied between the cases and modules; modules were adjusted to customer scale, or in their content, or both (e.g. workplace design adjusted to customer’s size and business process.

Generally the stages suggested by the typology of *operational approach to customization* were not sequential but overlapped. Hence the typology was not valid in the context of KIBS. The advertising agency is a good example of a service portfolio that flexibly blends all types of modularity and customization and therefore blends all operational approaches too. Moreover, real life was not as precise as the original typology, which also challenged its application to KIBS.

Finally, we look at the role of modularization in service innovation. In the building services consultancy, modularity has a fundamental role as the technological innovation (information system/software) enabled the firm to attach the client’s monitoring systems to its integrator system (bus modularity). Interestingly, in this case some modules
attached to the base were thus provided by the client, not the service provider. The service was first offered as a bundle but soon unbundled as different customer needs were recognized. However, the service was not marketed as a modular product but sold as different service levels and the software as a product on its own.

The workplace design service used modularity to develop its offering into a ‘productized’ form. The innovation was based on a totally new value proposition, but strong modularization clearly facilitated its success. Moreover, the firm has started mapping out the possibility of unbundling the service modules. One module has already been used for another offering (component sharing), a spin-off innovation from the workplace design.

The marketing offering was fundamentally based on modularity, as the innovation was to connect existing services together as one integrated value proposition, increasing the value for the client. The holistic approach allowed a more strategic orientation in planning marketing as client’s partner.

In the accounting case, the service was modular originally, although the value proposition was not based on modularity. The firm recognized two related market needs emerging from the new regulations, and organized their offering as modules. This was an organizational solution, too, because the modules required different expertise. Also in other cases modularization was used to coordinate expertise between individual professionals and clients.

5 Conclusions and discussion

All cases exhibited some form of customization and modularity. Standardized customization was transparent in two cases. Customization was sometimes based on selection of modules, but often modules were bundled and customization introduced by choosing the best bundle and tailoring it. Novel customer needs not satisfied by existing bundles fuelled the development of new innovative modules. Modularization was not used for mass-customization purposes. Rather, it was a tool to systematise and standardize services and to deploy innovations in new combinations, spinning off new offerings. The study supports earlier literature [10], and indicates that *several innovation mechanisms may play a role in single service innovation.*

Peters and Saidin [22] argued that services utilize sectional or bus modularity. Our findings indicate that *a broader range of modularity applies to services.* Most modules represented the cut-to-fit type, and we argue that this is because of the extensive customer involvement (clients brought essential elements to service modules). Intangibility characteristics of service complicated the analysis, indicating that current modularity frameworks are too straightforward for service contexts, while they certainly have a lot to contribute to service innovation research. Current models do not pay attention to the frequent need to tailor service processes simply because the client is a co-producer of the service.

The ‘principle’ of modularization varied in our cases. In the advertising agency the whole service repertoire was seen as modular and integrated. This explains why we identified the broadest range of modularity in this case. In other cases the studied offering represented a single product family in the firm’s service portfolio.

The concept of basic modules by Pahl and Beitz [21] is problematic in the service context, when one accepts the idea of the augmented service offering [12]. The basic
module concept suggests the core service cannot be tailored, which is not correct based on our evidence: even core modules were “cut-to-fit”. However, the core of a service might consist of several modules, and then such basic modules might be found. Our coarse analysis circumvented the idea of augmented service offering, and thus we suggest this as a problem for further research.

Our study indicates that as the modularization theory is developed in the context of mass-customization, it has limited applicability in analyzing single offering. The studied cases were innovative service products instead of portfolios of offerings, except in the case of the advertising agency. The main method of customization was through tailoring with cut-to-fit modules, whereas the modular product structure enabled more systematic operations, exploiting individual expertise and reproduction of the innovation in further product variations.

Although the operational approaches typology was found inapplicable in this study, we avoid making general conclusions about its validity in services. It does not work for pure, knowledge intensive services, but might work with ‘good-service-hybrids’ including separate assembly phases.

Earlier authors have emphasized the importance of modularization as a way to reconcile the apparently contradictory requirements of standardization and customization (Sundbo and Gallouj 2000). Our study supports this, but emphasizes that modularity has relevance beyond mass-customization. Modular product structures do not automatically lead to mass-customization. Although modularization has spread in services, only a fraction of service firms mass-customize. Often this is because the services are not produced in mass volumes.

Sundbo connects modularization with the bundling-unbundling-rebundling strategies suggested by Normann [20], recognizing the difference between the market focus of bundling and the production focus of modularization. We agree. However we perceive bundling as a marketing originated concept; we perceive that modularization, as a term, points to both two perspectives depending on the context in which it is used. The mass-customization literature emphasizes the market perspective, whereas the production systems literature focuses on the production aspects and product architecture. This reflects the background that modular product structures were first used for mass production purposes and later perceived as the enabling structure for mass customization. We argue that in KIBS, modularization has to do more with effective production than mass customization.

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