University of Groningen

What professionals consider when designing a modular service architecture

Broekhuis, Manda; van Offenbeek, Marjolein; van der Laan, Monique

Published in:
International Journal of Operations & Production Management

DOI:
[10.1108/IJOPM-05-2015-0306](https://doi.org/10.1108/IJOPM-05-2015-0306)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2017

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Broekhuis, M., van Offenbeek, M., & van der Laan, M. (2017). What professionals consider when designing a modular service architecture. *International Journal of Operations & Production Management*, 37(6), 748-770. <https://doi.org/10.1108/IJOPM-05-2015-0306>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

International Journal of Operations & Production Management

What professionals consider when designing a modular service architecture?

Manda Broekhuis, Marjolein van Offenbeek, Monique Eissens-van der Laan,

Article information:

To cite this document:

Manda Broekhuis, Marjolein van Offenbeek, Monique Eissens-van der Laan, (2017) "What professionals consider when designing a modular service architecture?", International Journal of Operations & Production Management, Vol. 37 Issue: 6, pp.748-770, <https://doi.org/10.1108/IJOPM-05-2015-0306>

Permanent link to this document:

<https://doi.org/10.1108/IJOPM-05-2015-0306>

Downloaded on: 28 August 2017, At: 05:12 (PT)

References: this document contains references to 62 other documents.

To copy this document: permissions@emeraldinsight.com

The fulltext of this document has been downloaded 133 times since 2017*

Users who downloaded this article also downloaded:

(2017), "Service modularity and architecture – an overview and research agenda", International Journal of Operations & Production Management, Vol. 37 Iss 6 pp. 686-702 <https://doi.org/10.1108/IJOPM-03-2017-0191>

(2017), "Exploring modularity in services: cases from tourism", International Journal of Operations & Production Management, Vol. 37 Iss 6 pp. 771-790 <https://doi.org/10.1108/IJOPM-08-2015-0531>

university of
 groningen

Access to this document was granted through an Emerald subscription provided by emerald-srm:211952 []

For Authors

If you would like to write for this, or any other Emerald publication, then please use our Emerald for Authors service information about how to choose which publication to write for and submission guidelines are available for all. Please visit www.emeraldinsight.com/authors for more information.

About Emerald www.emeraldinsight.com

Emerald is a global publisher linking research and practice to the benefit of society. The company manages a portfolio of more than 290 journals and over 2,350 books and book series volumes, as well as providing an extensive range of online products and additional customer resources and services.

Emerald is both COUNTER 4 and TRANSFER compliant. The organization is a partner of the Committee on Publication Ethics (COPE) and also works with Portico and the LOCKSS initiative for digital archive preservation.

*Related content and download information correct at time of download.

What professionals consider when designing a modular service architecture?

Manda Broekhuis

*Department of Operations, University of Groningen,
Groningen, The Netherlands, and*

Marjolein van Offenbeek and Monique Eissens-van der Laan
University of Groningen, Groningen, The Netherlands

Abstract

Purpose – The purpose of this paper is to explore how functional and appropriateness arguments influence the adoption of modularity principles during the design of a professional service architecture.

Design/methodology/approach – Action design research was conducted to examine the design process of a modular service architecture for specialised elderly care by a multi-professional group. Data collection methods included, partly participatory, observations of the interactions between professionals during the design process, interviews and document analysis. Data analysis focussed on the emerging design choices and the arguments underlying them.

Findings – A wide range of both functional and appropriateness considerations were enlisted during the design process. The three core modularity principles were adapted to varying degrees. In terms of the design outcome, the interdependencies between the modularity principles necessitated two trade-offs in the modular design. A third trade-off occurred between modularity and the need for professional inference where services were characterised by uncertainty. Appropriateness was achieved through the professionals reframing and translating the abstract modularity concept to reconcile the concept's functionality with their professional norms, values and established practices.

Originality/value – The study adds to service modularity theory by formulating three trade-offs that are required in translating the core modularity principles into a functional set of design choices for a multi-professional service environment. Moreover, the inherent intertwinedness of the core modularity principles in professional services requires an iterative design process. Finally, the authors saw that the ambiguity present in the service modularity concept can be used to develop a design that is deemed appropriate by professionals.

Keywords Service modularity, Professionalism, Design process, Elderly care

Paper type Case study

Introduction

A modular service architecture could be an attractive option for professional service organisations that operate in environments with varying degrees of competition. Modularity refers to the unravelling of a complex offering into multiple often simpler parts that function independently and which in turn can be recombined in many different ways (Ulrich, 1995; Schilling, 2000; Voss and Hsuan, 2009). Modularisation promises enhanced flexibility in delivering more coherent and transparent services to diverse customers at comparatively low costs (Pekkarinen and Ulkuniemi, 2008; Voss and Hsuan, 2009; Bask *et al.*, 2010; de Blok *et al.*, 2014). However, in practice, constraints are encountered in devising modular service architectures, especially in professional services (e.g. Brax and Toivonen, 2006; Bask *et al.*, 2010; Dörbecker and Böhmman, 2013).

This impression motivated this study where we set out to explore, from the perspective of the professionals themselves, how and to what extent modularity principles can be designed into a professional service architecture. To date, the degree of service modularity achieved in practice seems to be modest (Eissens-van der Laan *et al.*, 2016), and the modularity principles' application is barely explained (Meyer and DeTore, 2001; Voss and Hsuan, 2009; Bask *et al.*, 2010;

de Blok *et al.*, 2010, 2013; Rahikka *et al.*, 2011). Further, when a design process for modularity in professional services is described, the process is not reflected upon (Meyer and DeToreb, 2001; Chorpita *et al.*, 2005; Meyer *et al.*, 2007). Moreover, Dörbecker and Böhmman (2013) show how scholars have overlooked the risks and negative effects of modular service designs. They argue that possible trade-offs in design choices need to be explored in order to identify boundary conditions for the application of service modularity. In-depth case studies are thus needed to tackle these design issues (Bask *et al.*, 2010).

To this end, we conducted action design research (ADR) within a specialised elderly care centre. A multidisciplinary group of professionals was attempting to modularise a service offering. In our analysis, we acknowledge that practitioners when making sense of a new design challenge will, at least initially, start reasoning from their existing frames of reference (Weick *et al.*, 2005). Practitioners inevitably have their own established social norms, values, rules and routines (Scott, 1995; Barley and Tolbert, 1997). These will somehow guide the translation of the modularity principles into practice and serve to legitimise the design outcomes to others in their field. Previous research has already shown how the adoption of an innovation in professional services design depended on the extent to which it satisfied the functional requirements and was seen as culturally, politically and legally legitimate (Van Offenbeek *et al.*, 2009). The latter categories are closely intertwined and, when taken together, have been labelled as “appropriateness” criteria (March and Olsen, 1995). The core idea of appropriateness is that organisations and the actors within them respond not only to the functional demands of their work activities but also to broader ideas and norms in their industry or field. We therefore asked:

RQ. How do functional and appropriateness arguments influence the adoption of modularity principles during the design of professional services?

As the service modularity concept has proved to be ambiguous (Dörbecker and Böhmman, 2013), the study’s theoretical contribution lies in showing how in a specialised elderly care setting this inherent ambiguity may be used to develop a design that is deemed appropriate for that task environment. Second, our research demonstrates how tensions between functional requirements and between functional and appropriateness arguments affect the design choices made. The required trade-offs result in an only partial adoption of the modularity principles. The practical contribution lies in the increased awareness of the challenges involved in designing a modular professional service architecture. Such awareness will better equip practitioners to make the identified trade-offs and overcome hurdles in designing modularity, thereby increasing the likelihood of delivering the promised benefits.

The paper first discusses service modularity theory to analyse the functional design requirements for service modularity from which five design choices emerge. We also discuss the latter’s complexity in a professional services setting. Next, we explain how we used the logic of appropriateness in this study. Following this, we explain how combining functional and appropriateness lenses leads to the choice to undertake ADR. We then present the findings and highlight several trade-offs that emerge in the professionals’ argumentation during the design process. To conclude, the implications of these trade-offs are discussed.

Modularity: functional feasibility and appropriateness in professional services

Functional requirements: three modularity principles

The essential parts of a modular design are labelled as modules: relatively independent parts of a service offering each with a specific function and a standardised interface (Rajahonka, 2013, p. 47). This definition reflects the three core modularity principles that modules should: have a specific function, be relatively independent, and have standardised interfaces for integration purposes (Ulrich, 1995; Baldwin and Clark, 2000; Schilling, 2000).

The “specific function” principle involves a module having a specific functional purpose and being reusable in different systems with no or only minor revisions (Bask *et al.*, 2014). The pre-specification of service modules provides a basis for configuring customer-specific service offerings (Bask *et al.*, 2014). Various ways of decomposing a service offering into separate functions have been identified (Eissens-van der Laan *et al.*, 2016). First, these approaches vary in the number of decomposition layers, i.e. in the level of detail (Ulrich and Tung, 1991). Eissens-van der Laan *et al.* (2016) show that a service offering may be decomposed into a single layer of modules, as in the decomposition of home care by de Blok *et al.* (2010), or into a detailed tree-like structure with multiple layers. A good example of the latter is the decomposition of a banking service by Moon *et al.* (2010). Second, this division can be outcome- or process-oriented (see Grönroos, 2000). Outcome-oriented decompositions generate modules with a clear purpose in terms of adding value, e.g. for the customer. Examples are “weight control” and “diet modification” modules in outpatient care for chronic hypertension (Bohmer, 2005). In process-oriented decompositions, modules address the specific functions of (sub-)processes or encounter-processes within the service offering as a whole. For example, case management could be split into modules such as “case screening” and “care management plan creation” (Meyer *et al.*, 2007).

The “relative independence” modularity principle refers to the idea that the components that make up a module are interdependent on one another whereas between modules the interdependencies are minimal (Baldwin and Clark, 2000; Campagnolo and Camuffo, 2010). As a result, specific details of the contents and processes of a module can be kept within it and the need for information exchange between modules is minimised (Chorpita *et al.*, 2005). It follows that a critical design activity when designing a modular service offering is to analyse interdependence patterns between service elements (Baldwin and Clark, 2000).

The final modularity principle is “standardised interfaces”. Interfaces describe and enable connections between modules in a service offering, and are key to mixing and matching modules to create menu-driven customisation (Voss and Hsuan, 2009). In services, one can make a distinction between two complementary interfaces: functional and organisational. Functional interfaces connect and align the functions of different modules (Fixson, 2005). Standardising functional interfaces involves the formulation of rules for mixing and matching modules that determine which combinations can be delivered and the degree of customisation attainable within a modularised architecture (Bask *et al.*, 2014). Organisational interfaces between modules coordinate the activities among providers and between providers and customers (de Blok *et al.*, 2014). To the extent that organisational interfaces are standardised, the interactions among involved service providers become predictable (de Blok *et al.*, 2014). Theoretically, coordination costs can be reduced by standardising outputs to ease interaction between modules and by using throughput standardisation to coordinate within modules (Mintzberg, 1979). However, since within-module standardisation does not serve a functional requirement (Eissens-van der Laan *et al.*, 2016), the potential cost reduction needs to outweigh the decrease in flexibility.

Design choice tensions resulting from the modularity principles

The modularity principles can be turned into five key design choices that are elaborated and summarised in Table I.

In determining the number of decomposition layers (Design choice 1), a balance is sought between a broad, generic decomposition on a single layer and a detailed tree-like decomposition on multiple layers. An architecture with broad generic module provides limited transparency and direction, and may still require a high level of personalisation during service delivery. Conversely, a detailed decomposition leads to a service architecture that offers high variety, but is also relatively more costly to develop and maintain and less understandable for clients (see Table I).

Main modularity principles	Definitions	Design choices	Examples of design choices	Professional services' characteristics expected to complicate modularity
Specific function	A module performs a certain operation or function (Baldwin and Clark, 2000)	Number of decomposition layers (Design choice 1)	A single-layer outcome-oriented decomposition. For example, modular outpatient care for chronic hypertension with modules for weight control, diet modification, drug therapy and stress control (Bohmer, 2005)	The more heterogeneous the customer demands and the more customers that tend to play an active role by providing labour or information inputs, the greater the input uncertainty (Larsson and Bowen, 1989). We believe that, consequently, the harder it is to prespecify modules with a specific function
	Modules have a clear, unique and definite function and have the same functional purpose in different systems (Bask <i>et al.</i> , 2010)	Outcome-oriented, process-oriented, or combined decomposition (Design choice 2)	A multi-layer combined decomposition. For example, decomposition into 17 outcome-oriented modules (e.g. deposit, withdraw, transfer, statement) plus activity diagrams to identify separate processes for each outcome-oriented module (e.g. make a deposit, transfer money, write a cheque (Moon <i>et al.</i> , 2010)	Professionals can often not guarantee an effective outcome, e.g. doctors cannot guarantee cure (Gerrity <i>et al.</i> , 1992). Selecting an orientation touches on the dilemma that outcome-oriented modules might express more than can be guaranteed, whereas process-oriented modules might stick too closely to process steps that are defined based on the profession (e.g. diagnosis, treatment, after-care) and obscure the added value or benefits for clients
Relative independence	Draws on the concept of "nearly decomposable", as discussed by Simon (1962) who theorised that, in nearly decomposable systems, the interactions among the subsystems are weak, but not negligible	Degree of "relative independence" to be attained (Design choice 3)	A modular architecture with pooled interdependencies between decomposed parts. For example, post and package services are decomposed into: letter, e-post, package and warehousing (Bask <i>et al.</i> , 2010)	Elements and activities of a professional service offering or package are often highly interconnected (Von Nordenflycht, 2010) and we assume this complicates the identification of independent parts High levels of throughput uncertainty reflect high levels of process variability and low levels of process analysability (Perrow, 1970). We believe that the more unexpected events occur during service delivery and the less knowledge that

(continued)

Table I.
Three modularity principles leading to five design choices and expected complications in professional services

Table I.

Main modularity principles	Definitions	Design choices	Examples of design choices	Professional services' characteristics expected to complicate modularity
Standardised interface	Prescription of how two modules in a modular system mutually interact (Salvador, 2007)	Degree of interface standardisation, both functional and organisational (Design choice 4)	Standardised functional interface, e.g. product books for module selection, simple and easy to follow rules to direct medical and sequential interactions (de Blok <i>et al.</i> , 2014)	exists about cause-effect relationships (Thompson, 1967), the harder it is to identify relatively independent modules A professional service is often consumed over an extended period, with different modules provided at different times. This requires interfaces in a professional service offering to govern both the flow of information and of customers (de Blok <i>et al.</i> , 2014)
	"[...] the set of rules and guidelines governing the flexible arrangement, interconnection, and interdependence of service components and service providers" (de Blok <i>et al.</i> , 2014, p. 30)	Degree of within-module standardisation (Design choice 5)	Standardised organisation interface, e.g. guide flow of information among service providers and client meetings (de Blok <i>et al.</i> , 2014) Within-module standardisation: support customer flow between components by eliminating medical and sequential barriers (de Blok <i>et al.</i> , 2014)	A professional service offering may need adaptation over time to meet changing customer needs, requiring interfaces that are sufficiently flexible to accommodate this change (de Blok <i>et al.</i> , 2014) Multiple, often highly specialised, professionals and customers play a role in service delivery. This means that interfaces have to connect professionals together and connect professionals with customers (de Blok <i>et al.</i> , 2014; Voss and Hsuan, 2009)

In terms of decomposition orientation (Design choice 2), both outcome and process orientations and the combinations of the two are found (Eissens-van der Laan *et al.*, 2016). Modules specified by their outcomes provide transparency to customers (Pekkarinen and Ulkuniemi, 2008), and seem to be favoured when aiming to offer variety. Conversely, in service systems with a focus on low-cost delivery, a process-oriented decomposition seems to dominate (Eissens-van der Laan *et al.*, 2016). In selecting an orientation in professional services there is the danger that outcome-oriented modules might express more than can be guaranteed while process-oriented modules might stick too closely to process steps whose definitions are based on the profession (e.g. diagnosis, treatment, after-care) and obscure the added value or benefits for clients.

The second modularity principle (relative independence) links to Design choice 3: how to design relatively independent modules. This choice seems to run counter to a fundamental characteristic of professional services: that elements and activities in a professional service offering are often reciprocally interdependent (Thompson, 1967). In terms of throughput uncertainty (Perrow, 1970), the implication is that unexpected events occur relatively more frequently in professional services and less knowledge is available on the cause-effect relationship (Von Nordenflycht, 2010), making it hard to pre-specify relatively independent modules.

This throughput uncertainty also questions whether the service system can be decomposed in such a way that the information can indeed be kept within the modules (Chorpita *et al.*, 2005). A direct consequence is that the extent to which relative independence between the specific modules is realised determines to what degree standardised interfaces can be designed (Design choice 4). Finally, although within-module standardisation may enhance efficiency, it is not a functional requirement for a modular service architecture (Eissens-van der Laan *et al.*, 2016). This offers leeway for professional services that typically face throughput uncertainty. As such, the degree of within-module standardisation constitutes a distinct design choice (Design choice 5).

The extent to which and the form in which professionals adopt and apply the three modularity principles in designing a modular service architecture can be expected to be influenced by the functional requirements of modularity, but also by their perceived appropriateness within the specific task environment (Greenwood *et al.*, 2002).

The logic of appropriateness

Designing any service architecture constitutes a process of human action and decision making. The logic of appropriateness provides a perspective on how human action and decision making is to be interpreted (March and Olsen, 1995, pp. 30-31). Here, we explain this perspective, its contribution to our study and how we applied it.

The logic of appropriateness sees action as driven by the rules of appropriate or exemplary behaviour that are organised into institutions. Institutions are “social structures which are composed of cultural-cognitive, normative, and regulative elements that, together with associated activities and resources, provide stability and meaning to social life” (Scott, 1995, p. 33). As such, the appropriateness of rules includes both cognitive and normative components (March and Olsen, 1995, pp. 30-31). Considerations of appropriateness guide individuals and organisations in how they do things. Not necessarily by maximising utility, but by acting in a way that is seen as “appropriate” in their wider environment. It follows from this reasoning that appropriateness criteria should at least co-determine the structuring and organising of service offerings.

In our research context, the design of a modular service architecture will potentially be influenced by what is deemed appropriate in the health and social care sector and the professions involved. Each of these can be seen as providing enduring ideas, beliefs, rules and norms that affect the behaviour and beliefs of individuals and collective actors

(Powell and DiMaggio, 1991). Traditional professional values are based on the notion that professionals have to take complex decisions characterised by high task uncertainty (Evetts, 2003) and therefore require mastery over a complex body of knowledge coupled with specialised skills. In these decisions, inference takes place “when the connection between diagnosis and treatment is obscure” and is guided by the professionals’ knowledge and skills (Abbott, 1988). The need for inference legitimises professional autonomy and discretionary judgement (Evetts, 2003, 2011), and thus influences the way professional services are organised (Robertson and Swan, 2003). On the one hand, a new managerial concept such as modularity that in essence targets standardisation might be seen to interfere with these professional values and the codes of conduct and habits derived from them (Greenwood *et al.*, 2002; Robertson and Swan, 2003). On the other hand, this traditional notion of professionalism is today increasingly complemented with and partly replaced by new notions of professionalism that place considerably more emphasis on creating partnerships with customers and on multidisciplinary work (e.g. Bettencourt *et al.*, 2002). Given this changing focus in terms of values, professionals are expected to invest more in organisational activities such as planning, scheduling, communication and cooperation with both clients and other professionals (Noordegraaf, 2011). Related to this, performance indicators such as transparency and efficiency seem to have increased meaningfulness to professionals (Evetts, 2011; Gleeson and Knights, 2006).

A functional logic looking at expected consequences may to some extent overlap with a logic of appropriateness. While the analytical utility of distinguishing between the two logics has been debated (Goldmann, 2005), recent empirical work shows that considerations of appropriateness contribute to an actor’s behaviour (e.g. Wilhelm and Bort, 2013; Case *et al.*, 2015). For this study, it is therefore relevant that the appropriateness lens is applied since this allows the analysis of other than functional criteria that may be in play when designing a modular service architecture. Considering possible explanations from outside the service modularity and related literatures seemed important given the modest degree of service modularity actually achieved in the cases reported in the literature. In the Method section, we explain how the “logic of appropriateness” helped in identifying and labelling considerations that were central to the design choices eventually made.

Method

Research design

Action research focusses on generating knowledge in action, not about action (Coughlan and Coughlan, 2002), and the research approach taken here was typically design oriented (Sein *et al.*, 2011). ADR aims at generating design knowledge through building and evaluating an artefact, here a modular service architecture. The research attempted to respond to the organisation’s need for a modular architecture by building a concrete artefact for the specific context and from this distilling prescriptive knowledge that could be packaged into a general conceptual solution to address a class of problems (Sein *et al.*, 2011). In line with ADR, it was recognised that this modular design would emerge from the interaction with the organisational context and that the process was crucial for both practitioners and researchers (Iivari, 2015). While the practitioners initiated the research to realise a new service architecture, the researchers contributed with modularity theory and facilitated the iterative process of designing and evaluating (Coughlan and Coughlan, 2002). ADR enabled a holistic and in-depth understanding of the translation of modularity principles in the design process as it played out over time, leading to reflections on the applicability of modularity in a professional services context (Iivari, 2015).

Research context

This research was conducted in a Dutch health and social care organisation that was initiating a specialised centre for providing person-centred services to independently living

elderly people. The centre would focus on supporting general practitioners (GPs) in diagnosing older adults' heterogeneous and often interrelated problems and in offering interventions to address these problems (e.g. Mead and Bower, 2000). Several disciplines would need to collaborate to meet this new market demand. Revenues would be generated from private insurance companies who, in the Netherlands, are legally obliged to accept all applications for basic healthcare cover. Individuals can also opt for more extensive packages.

The unit of analysis was the design process for this modular service architecture. A taskforce comprising experts from ten disciplines was established to build the architecture. Potential customers were not involved as management felt that participation by the elderly would further complicate the design process with unforeseeable implications. Instead, the customers' voice was indirectly represented through evidence-based descriptions of the specific health-related needs of two segments of the elderly population that the management had selected as the target group for the modular design. The descriptions were based on a large-scale regional segmentation study of older adults' experienced difficulties in fulfilling their biopsychosocial needs (Eissens-van der Laan *et al.*, 2014). The first segment consisted of elderly adults experiencing difficulties in their psychosocial functioning. These felt they were getting older, were experiencing feelings of loneliness and were not comfortable with ageing. The second segment was experiencing difficulties in mobility and physical functioning. They experienced their difficulties as temporary or at worst not deteriorating, and did not feel lonely or abandoned.

The design process encompassed three stages. First, two researchers gave a presentation on service modularity and introduced the two segments to be targeted. This is in line with the action design principle that the initial design effort is informed by theory (Sein *et al.*, 2011). Then, in the second stage, the taskforce was invited to discuss their aims in providing diagnostic, prevention and treatment services to these segments. Thereafter, the taskforce developed a modular service design during seven subsequent plenary meetings, three small-group sessions and, in between these, virtual discussions, evaluations and adjustments (Table AI). In the third stage, the outcome design was evaluated.

Researchers' role

Two researchers informed the design effort by introducing modularity concepts and acting as facilitators during the design process. The researchers also provided administrative support and feedback based on their observations and taped recordings of the meetings. One researcher gathered the input from the participants, both during and between activities, and assembled this in the form of tables, figures and flowcharts that formed inputs for the subsequent design activity together with a proposed agenda. This researcher also offered guidance and assistance, whereas the second researcher adopted more of an observing role. A third researcher helped the other two to reflect before, during and after the research. Despite the significant inputs from the researchers, the professionals remained in the lead throughout the process in terms of the design choices made.

Data collection

To achieve internal triangulation (Miles and Huberman, 1994), data on the design process were collected in multiple ways: observations and recordings of all meetings and sessions; 14 semi-structured retrospective interviews with the 12 taskforce members and two responsible managers approximately four months after the end of the design process; and a study of internal documents including the business case for this specialised elderly care centre and outputs from the modularity design meetings. We kept a logbook during the design process and transcribed all the plenary meetings and interviews, generating around 350 pages of transcripts. The plenary meetings provided data related to design

activities, critical events and design choices made during the process (see Langley, 1999). The interviews helped reflect on experiences with the design process and outcomes, and varied in length from 45 to 90 minutes. Informal conversations, e-mails and intermediate conversations with managers added to the data. The data were collected between February 2012 and December 2012.

Data coding and analysis

A time-ordered display (Miles and Huberman, 1994) outlined the design activities, the critical events that in hindsight determined the future direction of the design process and the design choices made. This detailed description of the design process provided a chronology for subsequent analysis (Langley, 1999), see Table AI. The second step involved coding the arguments used by the professionals during the meetings, interviews and e-mail exchanges. An ongoing iterative process led to 28 mutually exclusive and exhaustive codes (Table AII) representing the considerations voiced during the design process (Anand *et al.*, 2007). Third, small graphical representations of the considerations used by the professionals during the design stage were created and added to the design choices. Fourth, the third researcher elicited and questioned the interpretations of these representations. Finally, the interpretations of the design choices were compared to the graphical chronology.

Findings

Here, we identify the particular design choices that were made, and analyse the arguments the professionals enlisted to legitimise these choices. We also analyse what can be learned from these design choices about the functional feasibility and appropriateness of the three modularity principles within this research context. An overview of this analysis is provided in Table II. To guide the reader, references to this table are provided between parentheses in the text.

The taskforce had difficulties in coming to terms with both the design choices associated with the “specific function” modularity principle. The first issue concerned balancing the range of specific functions offered with the costs involved in designing and maintaining a detailed modular architecture (Design choice 1, number of decomposition layers). The professionals talked about which customer values they should be meeting for the two targeted groups of elderly people. They then tried to translate these values into concrete service offerings, each with a clear function in line with modular design requirements. However, in doing so, they produced long and diverse lists of services that they should be providing and variations in how these services could be provided (e.g. group or individual based; online or face-to-face). They reflected on how these different options would create valuable variation in customer services. The “brainstorming” nature of these meetings is visible in the following quotes: “We can offer a service on how to deal with cognitive problems, such as through mutual support [...] which we can also offer to partners” (a GP); “We can do so by providing information or by training” (another GP); “We can offer a digital training tool” (an occupational therapist).

Conversely, because of the need for economic viability, they only wanted modules that would be attractive to a substantial proportion of their customers (market consideration) and not offer all options to all customers: “If we offer the intensive diagnostics to everyone, this will become too expensive” (GP) (resource consideration). On the other hand, they felt their service offering should cover the envisaged variety in elderly needs. This leads to concerns such as, “if an element or activity is not included in our modular service architecture, will we still be allowed to offer it [professional autonomy], since at least a few customers will really need it (psychologist) [customer-centred consideration]”. As such, the difficulty was not only to address functional requirements, i.e. creating a manageable number of sufficiently concrete modules that would meet the heterogeneity in customer

Design choices	Functional considerations	Appropriateness considerations
Number of decomposition layers (Design choice 1)	Should every possible service be part of the modular architecture (is that efficient given service volumes)? Creating variety to meet needs of all customers while having sufficiently concrete modules that can be offered on their own Allowing personalisation while providing customers transparency and professionals guidance in services delivered ("module is not a shop") Pre-specifying the "what" (function) of modules; but not the "how"	Economic viability: market considerations and resource considerations Professional autonomy, customer-centred considerations Commitment considerations
Orientation of decomposition (Design choice 2)	Creating modules with a clear value for a specific target group while being recognisable for professionals	Professional rules and autonomy Habits and routines Facilitation of customer participation Market and strategic considerations
Degree of "relative independence" to be attained (Design choice 3)	The requirement for inference activities before intervention modules can be assembled while diagnostic information is needed during intervention delivery as well Variety is created by separating into diagnostic and intervention modules, but can a diagnosis be seen as a customer-oriented benefit "Who should be involved in which module" given the module's specific function: choosing between monodisciplinary (might increase dependencies with other modules considering the biopsychosocial needs of customers) and multidisciplinary modules (including components from different professional domains within a module might increase the relative interdependency of a module) Functional interface: rule-based referral based on the outcomes of the basic diagnostic modules possible, while need for intricate knowledge (inference) hinders establishment of referral rules for intervention modules	Resource considerations (avoiding doing things twice) and customer-centric perspective (to avoid overburdening customers) Evidence-based (diagnosis should meet professional standards) and customer-centric considerations (meeting individual customer needs) Customer-centric considerations (multidisciplinary needs) Habits and routines (monodisciplinary) Occupational boundaries (who is allowed to do what) Political considerations (accepting or not that a discipline is not involved in a module; who is to decide) Professional autonomy
Degree of interface standardisation, both functional and organisational (Design choice 4)	Organisational interface: redistribution of tasks and delegation from different disciplines to one single discipline leads to reduction in work interdependencies→simplifies handover to other modules Complexity of client needs and characteristics prevents high-level standardisation of the delivery process for intervention modules, or renders this inefficient	Resource considerations and customer-centric perspective (customer seeing fewer different faces; adopting a holistic approach) Resource considerations
Degree of within-module standardisation (Design choice 5)		Professional autonomy (personalisation within modules according to professionals' judgements and preferences legitimised by their specific experience and expertise) Habits and routines (a professional value-based habit to approach clients as unique cases and not consciously identify similarities)

Table II.
The dominant considerations surfacing in the design process

needs, but also with what they deemed to be an appropriate way of working such as leaving room for professional discretion. They accepted the appropriateness of designing for customers' self-experienced needs, and of pre-specifying modules for specific target groups, but, as professionals, they had to adapt their mindset. This tension was resolved when a nurse practitioner asked about the difference between a modular service architecture and a care pathway: "wasn't that [the latter] designed for a specific customer segment as well?" Others replied that "a care pathway is more of a set of pre-defined steps [...] while with this [modular service architecture] you look more at what people need, which building blocks" (GP) and, in comparing care pathways with modularity, concluded that "[...] this [modularity] offers us much more flexibility" (physiotherapist) (commitment-participation, professional autonomy). The realisation that the quest for evidence-based standardisation was not unreasonable and that by mixing modules they could retain flexibility enabled them to accept that a module's content would in itself be fixed: "a module is not a shop from which the appropriate components are then selected for each customer" (physiotherapist). The pre-specified module content (the "what" to deliver) would provide professionals with direction in delivering an appropriate service package and offer transparency to both customers and professionals (provide transparency and guidance). They were also able to agree that "how to deliver a module" could be left to the discretion of the professionals on the basis that, having listed a vast range of intervention options, it became apparent that it would be uneconomical and impractical to specify each of these as a different module. They concluded that allowing variations in delivery modes and channels would offer the same functional flexibility. Delivery mode and channel were to be regarded as within-module choices that could be personalised to customer needs (Design choice 5, degree of within-module standardisation). As an example, informing customers about self-management could be delivered through a mix of online and offline channels, to individuals or to self-help or professional-led groups.

In terms of Design choice 2 (orientation of decomposition), the professionals had difficulty in deciding whether to decompose their service offerings into outcome-oriented or process-oriented modules or a combination of both. As discussed above, the professionals elaborated on the values they wanted to achieve for the two elderly customer groups targeted, and thus seemed to favour an outcome-oriented approach. However, two obstacles surfaced. First, formulating specific functions for each elderly customer group felt alien to the majority. As professionals, they were used to looking at the needs of individual customers, rather than of customer groups: "it is difficult as there is not a client in front of you[...] this makes it abstract and difficult" (nurse practitioner) (professional rules and autonomy). Second, the descriptions of the elderly segments were written in terms of the elderly's self-experienced needs, whereas the professionals were trained and accustomed to prescribing interventions based on medical conditions and afflictions. Initially, the professionals felt they could not prescribe specific service functions based on such customer-centred input: "[...] we are used to discipline-oriented working [...]" (physiotherapist) (habits and routines).

The breakthrough in resolving this design choice came when the geriatric physiotherapist suggested that the intended customer benefits could actually be seen as the specific functions used to define modules. He suggested developing intervention modules such as: "Staying safe and in balance", "Becoming fit and mobile" and "Remaining fit and active". This met approval. The psychologist said, "[...] labelling the treatment modules in this way [...] will appeal to the older adults". The social worker concluded: "[...] it will help to attract older adults to the centre [...]". These labels can be seen in the final modular design displayed in Figure 1.

The arguments for this outcome-oriented and customer-centred decomposition were that it would enable customers to participate in composing their service package and that it

Figure 1.
Part of the
design outcome

matched market and strategic considerations. This design decision then raised the question as to whether diagnosis and intervention could be combined within a module or should be separate. This touches upon the third design choice discussed below.

Design choice 3 (degree of relative independence between modules) is closely intertwined with the first two design choices. The taskforce's struggle as to whether diagnostic activities should be included in the intervention modules or whether to develop separate diagnostic modules is illustrative. The taskforce realised that offering separate modules would tremendously increase the variety in what they would have on offer (strategic consideration). Further, the taskforce felt that offering a customer-centred set of intervention modules was only appropriate if they had sufficient diagnostic information on the person that was ordered in a way that would fit their professional frame of reference (professional rules and regulations). Moreover, separating diagnosis and intervention would avoid redundancy in diagnostic activities. That is, the taskforce voiced the view that if each intervention module had its own diagnosis this would lead to "doing things twice" (geriatric physiotherapist) (costs) and "overburdening clients" (GP) (customer-centred consideration). This set of arguments resulted in the first decomposition layer being process-oriented (see Figure 1).

Throughout the design process the task group had struggled with deciding on a perspective for defining the specific functions of modules, i.e. a customer-centred perspective (such as for the intervention modules) or a more professional, supply-oriented perspective. The final trade-off was that the decomposition in the diagnostic modules would be relatively more professionally oriented. The contents of the basic diagnostic modules consisted of a fixed set of evidence-based tests (evidence-based).

Despite this well-argued design choice, small diagnostic components were added in the final design stage when designing details of the intervention modules, this shows that achieving independence between diagnosis and intervention remained difficult. Another clear example of the remaining interdependency relates to the "Coping component" that was aimed at diagnosing how a client responds to a broad variety of difficulties as an independently acting person. This could not be offered as a separate intervention module but needed to be coupled as a reusable component with other components in the diagnostic and intervention modules.

Another issue that regularly sparked debate was about the disciplines that might, or should, be involved in delivering a module (Design choice 4, degree of interface standardisation). At first, the description and labelling of customer-centred modules distracted from this issue, but disciplines later expressed concerns about not being involved. The “who-is-involved-in-which-module” discussion also addressed the issue as to whether they should offer multidisciplinary modules incorporating contributions from different disciplines to create customer value (customer-centred consideration), or modules based on occupation that reflected the way they were used to working (habits and routines). In this discussion, considerations of appropriateness prevailed, as the following quotes show. The physiotherapist argued for combining components delivered by multiple disciplines within a module: “[...] we should not think about modules which refer to specific professions such as “occupational therapy” [...] but we should think about a module like “elderly people getting physical exercise”. This physiotherapist often raised the question: “what do these elderly people really need?”, and argued: “[...] nursing home care is multidisciplinary [...] look at psychosocial care [...] that is delivered by the social worker and the occupational therapist [...] they do not argue “this is my job and that’s yours” [...] We should be able to accept that customers don’t visit the physiotherapist” (political consideration). Other taskforce members agreed and provided similar arguments. During a later e-mail conversation, the physiotherapist wrote: “I think mono-disciplinary modules do not offer the efficiency benefits of a modular service offering. We should focus on what we can offer a client, and how to combine our offerings into a module[...].” However, the social worker declined to contribute to specifying multidisciplinary modules on the basis of a need for professional inference: “[...] to us, each client is unique and so is their diagnosis and treatment[...].” Given that the social worker was unwilling to go along with a multidisciplinary approach, it was decided that modules aimed at solving psychosocial problems would be delivered by a single discipline (professional autonomy; habits and routines).

The feasibility of standardised organisational interfaces was shown to be intricately related to the level of standardisation within modules (Design choice 5, degree of within-module standardisation). The taskforce discussed how to execute the basic diagnostic modules and relied on evidence-based protocols and “national guidelines” in describing in detail which diagnostic tools and methods to use. This standardisation of work processes led to a discussion on the division of labour: “[...] can a nurse practitioner be allowed to do the MMSE [a diagnostic test] [...]” (occupational therapist), “[...] yes, if you provide her with the right instructions” (psychologist). The taskforce agreed that a nurse practitioner could deliver all the basic diagnostic modules on the grounds that this would lower labour and coordination costs and the customer would be confronted by fewer faces (resource and customer-centred considerations).

Multidisciplinary subgroups designed the other modules by determining “who would deliver what and when” within each module, and by specifying the coordination mechanisms (e.g. multidisciplinary meeting, information system or case manager). This design process was structured by one of the researchers who helped to visualise their design decisions as flowcharts, and in actor-activity diagrams that show which discipline or function executes which tasks and the handovers between them (Design choice 5).

For the majority of these modules, the required inputs from the various disciplines were pre-specified in hours per discipline. However, as described above, the professionals agreed that the process-related aspects within modules (i.e. the “how”: the duration, frequency, sequence, channel and mode) could be personalised during delivery (design choice 5). As a physiotherapist concluded, “[...] we can standardise the process; day 1 about food intake, day 2 training [...] yet, the intensity and the equipment should be adapted to the individual client’s needs [...]”. Thus, the professionals felt that the complex variety in elderly people’s characteristics would prevent complete standardisation of any intervention module’s delivery process (functional consideration). Appropriateness considerations also

featured: the professionals argued that they were used to referring clients to one another and, therefore, it felt familiar to informally combine their individual efforts within modules (habits and routines; professional autonomy). To sum up, the second, outcome-oriented layer in Figure 1 combines high standardisation within the basic diagnostic modules with moderate standardisation and high personalisation in the intensive diagnostic modules and in all the intervention modules.

The resulting design – a part is presented in Figure 1 – was discussed with the management of the centre. Since then, incremental changes to the modular service architecture have been made: it has been further developed based on early experiences, management preferences and external stakeholder demands.

Discussion

We have studied the process followed by professionals designing a modular service architecture for the delivery of specialised care for ambulant elderly people. Our basic question was:

RQ. How do functional and appropriateness arguments influence the adoption of modularity principles during the design of professional services?

Below, we first reflect on the sets of functional considerations voiced (see Table II) and how these explain the design choices made. Thereafter, we discuss the findings regarding the appropriateness considerations in the design process itself.

A modular professional services architecture: trade-offs between functional requirements

All three modularity principles were partially adopted. However, adoption of the “relative independence” and “standardised interfaces” principles was fairly limited. A central observation is that the design choices were highly intertwined and that this is inherent to the nature of service modularity. This discussion, therefore, focuses on the resulting tensions between the five design choices reported above. In the balancing of these tensions, three dominant patterns in the arguments emerged, each constituting a trade-off between functional requirements.

Trade-off 1: balancing “customer-centeredness” with professional inference and throughput uncertainty. Although decomposition into modules with specific functions that could be separately delivered was possible, relative independence was hard to achieve. A major tension in achieving this functional requirement was in developing a customer-centred modular architecture that would leave room for professional judgement and inference (Abbott, 1988). Professionals need to infer before deciding or negotiating on how to solve an individual customer’s problem. The balancing between these requirements is reflected in the modular design. On the one hand, customer-centeredness is achieved by: pre-specifying the module’s content, i.e., the “what”; providing multidisciplinary modules; decomposing these into outcome-oriented intervention modules; and personalising the “how” of the intervention modules. On the other hand, room for professional inference and for managing throughput uncertainty is safeguarded by: not including every service offer in the modular architecture; designing a process-oriented first layer consisting of diagnosis and intervention modules; aligning the standardised within-module design with evidence-based protocols and “national professional guidelines”; and leaving room for within-module personalisation to enable compliance with professional standards.

Trade-off 2: balancing number of decomposition layers with relative independence. The perceived nature of the work in terms of high task uncertainty and reciprocal interdependencies was experienced as prohibiting a detailed decomposition into multiple layers. Previous research has mixed findings on the reusability of modules or components in services that are characterised by high task uncertainty (Tuunanen and Cassab, 2011;

Bask *et al.*, 2014). In this study, we found that the more fine-grained the modularisation (Design choice 1, number of decomposition layers), the less independent the modules can be because of reciprocal interdependencies between modules (Design choice 3, relative independence), which prevent the standardised interfaces (Design choice 4, interface standardisation). As an illustration, the coping component ended up as a reusable component, and not as a module. This enabled coping to be part of other modules, which was necessary as its content and delivery process were found to be heavily interdependent on other components in the diagnostic and intervention modules. As such, standardised interfaces between a separate coping module and the other modules would have been impossible. The limited room for detailed decomposition also showed in the addition of small diagnostic elements to the intervention modules.

Trade-off 3: accepting limited within-module standardisation because of high throughput uncertainty in multidisciplinary modules. As a consequence of the different professional backgrounds involved and the inherent throughput uncertainty in such professional services, standardisation of the organisational between-module interfaces proved difficult. Nevertheless, the design of multidisciplinary modules does require a degree of pre-specified standardised coordination between disciplines in terms of the multidisciplinary staffing of each module. While this may reduce costs, the within-module coordination mechanisms will remain intensive (e.g. multidisciplinary meetings, case management) given the high throughput uncertainty. The third trade-off occurs because the higher the throughput uncertainty, the less within-module standardisation of the content and process of multidisciplinary modules is feasible (Design choice 5, degree of within-module standardisation). Only the modules' interfaces can, to a certain extent, be standardised (Design choice 4, degree of interface standardisation). The same trade-off can be recognised in the modular mental care design of Chorpita *et al.* (2005).

Modular design process: incorporating appropriateness considerations

Achieving customer-centeredness through multidisciplinary modularisation. Given the asymmetric knowledge between customer and professional (Von Nordenflycht, 2010), and also among professionals of different disciplines as witnessed in our study, separating functional requirements from appropriateness considerations is difficult. We observed how the involved professionals negotiated sufficient input from their own discipline when designing the range and content of modules in the service architecture. These negotiations reflected political considerations that got in the way of establishing modules that reflected a customer-centred outcome. In this respect, the inter-professional debate limited the political considerations as professionals had to at least legitimise their own share of a module and contribution to the modular architecture, *vis-à-vis* professionals from other disciplines in the design process. From this we conclude that having the disciplines involved in a service offering participate in the design process, forces discussion and decisions on their legitimate contributions to customer-based modules. Another more tentative conclusion is that, in multidisciplinary service environments, modularisation stimulates discussion on the when, the what, the by whom and the through which mechanisms can multidisciplinary coordination be agreed and pre-specified. Finally, we observed that the customers' perspective was much better represented when it came to designing the intervention modules than in the diagnostic modules, which could be explained by the first trade-off.

Reducing abstractness: reframing modularity principles. The application of modularity principles was found to benefit from reframing them in a way that connected to developments in the professionals' domains. An appropriateness consideration that dominated the start of the design process was the strong traditional professional value of seeing each client as a unique case. In contrast, with modularisation, one aspires to a reusable design rather than a

unique one for each individual customer. A breakthrough came when the professionals started to recognise a parallel with developments in their own professions that valued standardisation in the form of evidence-based guidelines and care pathways for each patient stream.

Dörbecker and Böhmman (2013), in their review, concluded that the application of standardised interfaces in services had so far only been theoretically explored. More recently, de Blok's *et al.* (2014) research has shown that coordination and integration of care professionals takes place through both formalised rules and behavioural linkages (e.g. established rules of communication and client meetings) and that both functional and organisational interfaces are required to ensure appropriate care delivery over time. Our empirical study adds to this literature by showing that although professionals find it difficult to distinguish between functional and organisational interface, that this is possible by reframing the functional interface to fit their existing practices. That is, functional interfaces in the form of mixing and matching rules became inclusion (or indication) and exclusion (or contra-indication) criteria that have a high legitimacy for care professionals.

Theoretical contributions and practical implications

Our study explicitly demonstrates potential hurdles that need to be overcome when professionals design a modular service architecture and also indicates where the opportunities lie. Its contributions are threefold. First, the study advances the conceptualisation of professional services modularity by showing three trade-offs in translating the three abstract modularity principles into a coherent set of concrete and acceptable design choices. The three trade-offs identified limit the degree of modularity attainable, but further research is required to clarify the extent to which they do so.

Second, our findings show that designing professional service modularity not only requires the balancing of functional requirements but also the alignment with appropriateness considerations. The more that the traditional values of professional autonomy and of seeing customers as unique human beings were enlisted, and the more existing work habits were stressed, the more the design choices came to reflect service practices "as usual" (Dougherty and Heller, 1994) rather than service modularity. Future research could explore whether and how management and customer participation might help to keep a more balanced focus on the objectives of modularity.

Third, this study adds to the modularity design theory in that it shows how the core modularity principles are inherently intertwined in a professional service such as specialised elderly care. We argue that this inherent intertwinedness demands an iterative design process in the sense that each new design choice needs to be followed by a review of, and alignment with, earlier choices: does the design still meet the core principles and where to accept trade-offs? Thus far, the modularity literature has paid little attention to the design process itself (Eissens-van der Laan *et al.*, 2016).

Practical implications directly follow from the discussion above that suggests the alignment between choices through an iterative design process; inter-professional dialogue to damp political arguments; and reframing to support commitment. Reframing principles such that they fit with terms more familiar to professionals (Dougherty and Heller, 1994) and relating them to topical professional developments can help make modularity meaningful (Gleeson and Knights, 2006; Evetts, 2011). Having a manager with decision-making authority on board may help in the negotiations among professionals surrounding appropriateness considerations. Future research could explore whether and how management and customer participation might help to keep the focus throughout the design process on the objectives of modularity.

Strengths and limitations. The professional ownership of the design process was a strength since, given the asymmetric knowledge and professional autonomy, it was critical that the professionals participated intensively in the design. Their participation represents a functional demand: it is their tacit knowledge that needs to be explicated when building

functional interfaces for instance. Professional autonomy also represents an appropriateness consideration in that, if a discipline had not been involved in an intermediate outcome, we experienced that the debate would simply restart. In this respect, it was regrettable that management was not always present to safeguard the strategic objectives and to attempt to ensure everyone was pulling in the same direction (Von Nordenflycht, 2010). Another limitation of the studied modularity design process was that the customers' voice was only present in the segment descriptions and towards the end when they were invited to comment on the institute's design offering. This was mainly due to appropriateness considerations, such as management feeling that getting and keeping the disciplines involved around the table was already sufficiently complex. However, with hindsight, having the segment descriptions introduced to the professionals by customer representatives might have helped in achieving a shared customer-centred sensemaking during the decomposition task.

Adopting ADR allowed us to engage with the professionals over a prolonged period during which feedback was regularly sought. To develop valid knowledge, this engagement needed to be balanced with dissociation from the professionals being studied (Arbnor and Bjerke, 1997). We did so by transparently documenting our work and by placing one of the three researchers in a distant, debriefing role. Finally, as in product environments (Baldwin and Clark, 2000), designing modularity in elderly care was a time-consuming process. At times, the time pressure experienced helped bring agreement on a design choice although one cannot be sure this was always the optimal one. Short-term design costs sometimes dominated longer-term financial considerations.

Generalisability of the findings and future research. Given that our ADR concerned one organisation, we are cautious in generalising our findings. In terms of professional service organisations, our case has two typical characteristics: it requires "knowledge intensity" and has a "professionalised workforce". Consequently, and in line with Von Nordenflycht's (2010) expectations, our elderly care case saw the use of professional autonomy, informal relationships and ethical codes. Whereas, in classic professional service organisations muted competition and the lack of external ownership allows for slack (Von Nordenflycht, 2010), elderly care in the Netherlands is seeing increasing competition and demands from the external stakeholders. Introducing a modular service architecture was seen as a way to counter slack and inefficiency. Consequently, we would expect the same set of considerations to only apply in a comparable type of professional service organisation in a similar increasingly competitive environment (Noordegraaf, 2011). Additional boundary conditions on generalising our findings can be derived from Malhotra and Morris (2009) who argue that heterogeneity in terms of the nature of professional knowledge, jurisdictional control and the nature of client relationships all influence the options available when organising professional services. Consequently, even if the arguments advanced are the same, the functional tensions may require a different balance resulting in different design choices. Furthermore, socio-political dynamics will vary across combinations of professions and types of professional service organisations such that the appropriateness considerations may play out differently. Further research could examine, refine and test our findings in different professions, types of professional service organisations and task environments (Malhotra and Morris, 2009; Von Nordenflycht, 2010; Noordegraaf, 2011) and, in this way, inform the debate on the generalisability of our findings.

References

- Abbott, A. (1988), *The System of Professions: An Essay on the Division of Expert Labor*, University of Chicago Press, Chicago, IL.
- Anand, N., Gardner, H.K. and Morris, T. (2007), "Knowledge-based innovation: emergence and embedding of new practice areas in management consulting firms", *Academy of Management Journal*, Vol. 50 No. 2, pp. 406-428.

- Arbnor, I. and Bjerke, B. (1997), *Methodology for Creating Business Knowledge*, Sage Publications, Thousand Oaks, CA.
- Baldwin, C.Y. and Clark, K.B. (2000), *Design Rules: The Power of Modularity*, The MIT Press, Cambridge, MA.
- Barley, S.R. and Tolbert, P.S. (1997), "Institutionalization and structuration: studying the links between action and institution", *Organization Studies*, Vol. 18 No. 1, pp. 93-117.
- Bask, A., Merisalo-Rantanen, H. and Tuunanen, T. (2014), "Developing a modular service architecture for e-store supply chains: the small- and medium-sized enterprise perspective", *Service Science*, Vol. 6 No. 4, pp. 251-273.
- Bask, A., Lipponen, M., Rajahonka, M. and Tinnilä, M. (2010), "The concept of modularity: diffusion from manufacturing to service production", *Journal of Manufacturing Technology Management*, Vol. 21 No. 3, pp. 355-375.
- Bettencourt, L.A., Ostrom, A.L., Brown, S.W. and Roundtree, R.I. (2002), "Client co-production in knowledge-intensive business services", *California Management Review*, Vol. 44 No. 4, pp. 100-128.
- Bohmer, R.M.J. (2005), "Medicine's service challenge: blending custom and standard care", *Health Care Management Review*, Vol. 30 No. 4, pp. 322-330.
- Brax, S.A. and Toivonen, M. (2006), "Modularization in business service innovations", *Proceedings of the XVIII ISPM Conference*, Vol. 20, pp. 103-119.
- Campagnolo, D. and Camuffo, A. (2010), "The concept of modularity in management studies: a literature review", *International Journal of Management Reviews*, Vol. 12 No. 3, pp. 259-283.
- Case, P., Sparks, P. and Pavey, L. (2015), "Identity appropriateness and the structure of the theory of planned behaviour", *British Journal of Social Psychology*, Vol. 55 No. 1, pp. 109-125.
- Chorpita, B.F., Daleiden, E.L. and Weisz, J.R. (2005), "Modularity in the design and application of therapeutic interventions", *Applied and Preventive Psychology*, Vol. 11 No. 3, pp. 141-156.
- Coughlan, P. and Coughlan, D. (2002), "Action research for operations management", *International Journal of Operations & Production Management*, Vol. 22 No. 2, pp. 220-240.
- de Blok, C., Luijkx, K., Meijboom, B. and Schols, J. (2010), "Modular care and service packages for independently living elderly", *International Journal of Operations and Production Management*, Vol. 30 No. 1, pp. 75-97.
- de Blok, C., Luijkx, K., Meijboom, B. and Schols, J. (2013), "The human dimension of modular care provision: opportunities for personalization and customization", *International Journal of Production Economics*, Vol. 142 No. 1, pp. 16-26.
- de Blok, C., Meijboom, B., Luijkx, K., Schols, J. and Schroeder, R. (2014), "Interfaces in service modularity: a typology developed in modular health care provision", *Journal of Operations Management*, Vol. 32 No. 4, pp. 175-189.
- Dörbecker, R. and Böhmman, T. (2013), "The concept and effects of service modularity – a literature review", *IEEE 46th Hawaii International Conference on System Sciences (HICSS)*, pp. 1357-1366.
- Dougherty, D. and Heller, T. (1994), "The illegitimacy of successful product innovation in established firms", *Organization Science*, Vol. 5 No. 2, pp. 200-218.
- Eissens-van der Laan, M., Broekhuis, M., van Offenbeek, M. and Ahaus, K. (2016), "Service decomposition: a conceptual analysis of modularizing services", *International Journal of Operations and Production Management*, Vol. 36 No. 3, pp. 308-331.
- Eissens-van der Laan, M.R., van Offenbeek, M.A.G., Broekhuis, H. and Slaets, J.P.J. (2014), "A person-centred segmentation study in elderly care: towards efficient demand-driven care", *Social Science and Medicine*, Vol. 113, July, pp. 68-76.
- Evetts, J. (2003), "The sociological analysis of professionalism occupational change in the modern world", *International Sociology*, Vol. 18 No. 2, pp. 395-415.
- Evetts, J. (2011), "A new professionalism? Challenges and opportunities", *Current Sociology*, Vol. 59 No. 4, pp. 406-422.

- Fixson, S.K. (2005), "Product architecture assessment: a tool to link product, process, and supply chain design decisions", *Journal of Operations Management*, Vol. 23 Nos 3/4, pp. 345-369.
- Gerrity, M.S., Earp, J.A.L., DeVellis, R.F. and Light, D.W. (1992), "Uncertainty and professional work: perceptions of physicians in clinical practice", *American Journal of Sociology*, Vol. 97 No. 4, pp. 1022-1051.
- Gleeson, D. and Knights, D. (2006), "Challenging dualism: public professionalism in 'troubled' times", *Sociology*, Vol. 40 No. 2, pp. 277-295.
- Goldmann, K. (2005), "Appropriateness and consequences: the logic of neo-institutionalism", *Governance*, Vol. 18 No. 1, pp. 35-52.
- Greenwood, R., Suddaby, R. and Hinings, C.R. (2002), "Theorizing change: the role of professional associations in the transformation of institutionalized fields", *Academy of Management Journal*, Vol. 45 No. 1, pp. 58-80.
- Grönroos, C. (2000), "Service management and marketing", *European Journal of Marketing*, Vol. 15 No. 2, pp. 3-31.
- Iivari, J. (2015), "Distinguishing and contrasting two strategies for design science research", *European Journal of Information Systems*, Vol. 24 No. 1, pp. 107-115.
- Langley, A. (1999), "Strategies for theorizing from process data", *Academy of Management Review*, Vol. 24 No. 4, pp. 691-710.
- Larsson, R. and Bowen, D.E. (1989), "Organization and customer: managing design and coordination of services", *Academy of Management Review*, Vol. 14 No. 2, pp. 213-233.
- Malhotra, N. and Morris, T. (2009), "Heterogeneity in professional service firms", *Journal of Management Studies*, Vol. 46 No. 6, pp. 895-922.
- March, J.G. and Olsen, J.P. (1995), *Democratic Governance*, Free Press, New York, NY.
- Mead, N. and Bower, P. (2000), "Patient-centredness: a conceptual framework and review of the empirical literature", *Social Science and Medicine*, Vol. 51 No. 7, pp. 1087-1110.
- Meyer, M.H. and DeTore, A. (2001), "Perspective: creating a platform-based approach for developing new services", *Journal of Product Innovation Management*, Vol. 18 No. 3, pp. 188-204.
- Meyer, M.H., Jekowsky, E. and Crane, F.G. (2007), "Applying platform design to improve the integration of patient services across the continuum of care", *Managing Service Quality*, Vol. 17 No. 1, pp. 23-40.
- Miles, M.B. and Huberman, A.M. (1994), *Qualitative Data Analysis: An Expanded Sourcebook*, Sage, Thousand Oaks, CA.
- Mintzberg, H. (1979), *Structuring Organizations*, Prentice-Hall, Englewood Cliffs, NJ.
- Moon, S.K., Shu, J., Simpson, T.W. and Kumara, S.R. (2010), "A module-based service model for mass customization: service family design", *IIIE Transactions*, Vol. 43 No. 3, pp. 153-163.
- Noordegraaf, M. (2011), "Risky business: how professionals and professional fields (must) deal with organizational issues", *Organization Studies*, Vol. 32 No. 10, pp. 1349-1371.
- Pekkarinen, S. and Ulkuniemi, P. (2008), "Modularity in developing business services by platform approach", *The International Journal of Logistics Management*, Vol. 19 No. 1, pp. 84-103.
- Perrow, C. (1970), *Organizational Analysis: A Sociological View*, Tavistock Publications, London.
- Powell, W.W. and DiMaggio, P.J. (1991), *The New Institutionalism in Organizational Analysis*, University of Chicago Press, Chicago, IL.
- Rahikka, E., Ulkuniemi, P. and Pekkarinen, S. (2011), "Developing the value perception of the business customer through service modularity", *Journal of Business and Industrial Marketing*, Vol. 26 No. 5, pp. 357-367.
- Rajahonka, M. (2013), "Views of logistics service providers on modularity in logistics services", *International Journal of Logistics Research and Applications*, Vol. 16 No. 1, pp. 34-50.
- Robertson, M. and Swan, J. (2003), "Control – what control? Culture and ambiguity within a knowledge intensive firm", *Journal of Management Studies*, Vol. 40 No. 4, pp. 831-858.

- Salvador, F. (2007), "Toward a product system modularity construct: literature review and reconceptualization", *IEEE Transactions on Engineering Management*, Vol. 54 No. 2, pp. 219-240.
- Schilling, M.A. (2000), "Toward a general modular systems theory and its application to interfirm product modularity", *Academy of Management Review*, Vol. 25 No. 2, pp. 312-334.
- Scott, W.R. (1995), *Institutions and Organizations: Toward a Theoretical Synthesis*, Sage Publications, Thousand Oaks, CA.
- Sein, M., Henfridsson, O., Purao, S., Rossi, M. and Lindgren, R. (2011), "Action design research", *MIS Quarterly*, Vol. 35 No. 1, pp. 37-56.
- Simon, H.A. (1962), "The architecture of complexity", *Proceedings of the American Philosophical Society*, Vol. 106 No. 6, pp. 467-482.
- Thompson, J.D. (1967), *Organizations in Action: Social Science Bases of Administrative Theory*, Transaction Publishers, New York, NY.
- Tuunanen, T. and Cassab, H. (2011), "Service process modularization: reuse versus variation in service extensions", *Journal of Services Research*, Vol. 14 No. 3, pp. 340-354.
- Ulrich, K. (1995), "The role of product architecture in the manufacturing firm", *Research Policy*, Vol. 24 No. 3, pp. 419-440.
- Ulrich, K.T. and Tung, K. (1991), *Fundamentals of Product Modularity*, Springer, Berlin.
- Van Offenbeek, M., Sorge, A. and Knip, M. (2009), "Enacting fit in work organization and occupational structure design: the case of intermediary occupations in a Dutch hospital", *Organization Studies*, Vol. 30 No. 10, pp. 1083-1114.
- Von Nordenflycht, A. (2010), "What is a professional service firm? Toward a theory and taxonomy of knowledge-intensive firms", *Academy of Management Review*, Vol. 35 No. 1, pp. 155-174.
- Voss, C.A. and Hsuan, J. (2009), "Service architecture and modularity", *Decision Sciences*, Vol. 40 No. 3, pp. 541-569.
- Weick, K.E., Sutcliffe, K.M. and Obstfeld, D. (2005), "Organizing and the process of sensemaking", *Organization Science*, Vol. 16 No. 4, pp. 409-421.
- Wilhelm, H. and Bort, S. (2013), "How managers talk about their consumption of popular management concepts: identity, rules and situations", *British Journal of Management*, Vol. 24 No. 3, pp. 428-444.

Further reading

- March, J.G. and Olsen, J.P. (2004), "The logic of appropriateness", Working Paper No. 04/09, Arena, Oslo.

(The Appendix follows overleaf.)

Table AI.
Overview of the activities, events and choices during the modular design process

Meeting	1 (February 2012)	2 (March 2012)	3 (March 2012)	4 (April 2012)	5+6 (April-May 2012)	7 (May 2012)	8 (June 2012)
Design activities	The taskforce discussed designing care for elderly segments	The taskforce discussed how to specify functions for elderly segments	The taskforce listed components that can be delivered to fulfil the functions (as specified in previous session) The taskforce discussed what a module entails	The taskforce discussed the modules' nature (i.e. do modules combine diagnostic and treatment parts, or should separate diagnostic and treatment modules be decomposed)	Multidisciplinary subgroups within the taskforce designed the different types of modules in terms of what is delivered and how modules are delivered The whole taskforce discussed who should deliver the basic diagnostic modules and how older adults should be referred to intensive diagnostic modules	The taskforce discussed the modules' process nature, including the involved disciplines per module and how the care within a module is coordinated	The taskforce discussed the documents they developed with management during the design process
Critical events	Management gave a presentation and stated: the needs of two elderly segments are used as a starting point the supply need to be designed in a modular manner	The geriatric physiotherapist proposed a set of functions he would like to achieve for the two elderly segments	The geriatric physiotherapist proposed the idea that modules should involve a combination of multidisciplinary components that are interrelated content-wise	The GP and the specialist elderly care propose to distinguish among basic diagnostic, intensive diagnostic, and treatment modules specify diagnostic modules' functions based on domains of human functioning	No critical events	No critical events	No critical events

(continued)

Meeting	1 (February 2012)	2 (March 2012)	3 (March 2012)	4 (April 2012)	5+6 (April-May 2012)	7 (May 2012)	8 (June 2012)
Design choices	To specify functions in terms of benefits for the two elderly segments	To conceptualise a module in this service setting as a combination of (multidisciplinary) components which are interrelated content-wise and together fulfil a specific function	To decompose the service offering into basic diagnostic-intensive diagnostic, and treatment modules	To delegate multidisciplinary protocolled tasks within the basic diagnostic modules to one job	To explicate tasks and coordination mechanisms within multidisciplinary modules	To let the module's design allow for a degree of personalisation during delivery	To develop general process descriptions of monodisciplinary modules for psychosocial functioning

Table AI.

General codes	Descriptive codes	Examples
Specific function of a module	Specificity of the function of a module Contribution to overall service offering Problems in pre-specifying module(s)	"A module on how to cope with a disability is perhaps too broad" (specialist nurse) "Are there any other components in this module that may add to this module?" (geriatric specialist) "In our group, we found it very hard to distinguish what and how; but I think it's very good" (physiotherapist)
Relatively independence	Type of interdependency between modules Problems in decomposing into stand-alone parts/elements	"It is difficult to say what is a component and what belongs to a module and, if you make a cut, when do you have two different modules" (physiotherapist) (regarding coping) GP: "Can this be a module that you offer in every care provision?" ... "No, that is something in all four modules. That is not something you take apart (social worker) "Rule: If this is the outcome of this minimal diagnostics module, refer to the intensive diagnostics module" (In description of the final modular design) "Both lab results and patient come back to me" (dietician) "[...]multidisciplinary meetings. Please, no! These resolve nothing. These are always about the client, never with the client" (homecare manager)
Standardised interface	Coordination between modules Coordination between providers Coordination over time	"When the diagnostics module is completed, then we consult each other" (geriatric specialist) "[...][inflow of results from previous activities] may take months, but there will be a meeting and [the results] are fed back" (geriatric specialist) "[...] people with loneliness problems should not come to us. Loneliness is not in our budget. The insurance does not pay this" (meeting, 10 April) "[...] we have to look from an entrepreneurial perspective" (physiotherapist)
Appropriateness to economic context	Resource considerations Market considerations, e.g. market share, possibility of reimbursement	"[...] people with loneliness problems should not come to us. Loneliness is not in our budget. The insurance does not pay this" (meeting, 10 April) "[...] we have to look from an entrepreneurial perspective" (physiotherapist)
Appropriateness to professional context	Professional autonomy Occupational boundaries	"We will decide what modules clients will use" (GP) "In the event of complex problems, the specialised nurse has to refer a client to other professionals in intensive diagnostics" (GP)
Appropriateness to political constellation	(Change in) status, power or influence considerations Commitment and participation considerations Habits and routines	"Everybody fights for their own job [...] it's sometimes confrontational when deciding whether input from the dietician is really required in a module" (manager) "[This design process] provided collaboration. We looked with each other on what we all do" (dietician) "In the nursing home, we are used to multidisciplinary working" (psychotherapist)

Table AII.
Excerpt of
relevant codes

Corresponding author

Manda Broekhuis can be contacted at: h.broekhuis@rug.nl

For instructions on how to order reprints of this article, please visit our website:

www.emeraldgroupublishing.com/licensing/reprints.htm

Or contact us for further details: permissions@emeraldinsight.com

This article has been cited by:

1. BraxSaara A., Saara A. Brax, BaskAnu, Anu Bask, HsuanJuliana, Juliana Hsuan, VossChris, Chris Voss. 2017. Service modularity and architecture – an overview and research agenda. *International Journal of Operations & Production Management* 37:6, 686-702. [[Abstract](#)] [[Full Text](#)] [[PDF](#)]