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Applying the Configuration Paradigm to Mass-customize Contract Based Services

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Applying the Configuration Paradigm to Mass-customize Contract Based Services

Abstract

Satisfying needs of individual customers by mass-customizing services has been proposed. Although configuration, i.e. specifying a product individual as a combination of pre-defined components, is an important way of achieving mass-customization to industrial goods producers, there is relatively little literature on the applicability of the configuration paradigm to services. In this paper we take a step towards understanding if services could be managed as configurable products, and discuss the applicability of configuration modeling and configurator technology for managing services. The ideas presented in this paper originate both from existing literature and from our cooperation with four companies that participated our 3-year research project on configurable services and IT support for service configuration. We show that at least in some contract-based service industries configurable services exist and are used for doing business, and we characterize the services and related processes. We provide empirical evidence that basic configuration modeling mechanisms and configurators can indeed support management of configurable services, and discuss special requirements of services on configuration modeling and configurators.

Keywords

Configurable services; Service mass-customization, configurable products; configurator, case study

1 Introduction

Configurable products are one way to achieve the benefits of mass-customization. The design of a configurable product specifies a set of pre-designed elements and rules on how these can be combined in a routine manner without creative design into valid product individuals that meet the requirements of particular customers (Tiihonen & Soininen, 1997; Salvador & Forza, 2004).

Services are products with a significant service dimension e.g. (Kotler, 2003; Paloheimo et al., 2004). Research on *configurable services*, and development of *configurators* (Sabin & Weigel, 1998) particularly suitable for these, is relatively limited (da Silveira et al., 2001; Harvey et al., 1997; Papathanassiou, 2004; Akkermans et al., 2004; Wimmer et al., 2003; Peters & Saidin, 2000; Winter, 2001; Meier et al., 2002; Dausch & Hsu, 2003; Böhmann et al. 2003; Chen, 2005). It is not known if the special characteristics often attributed to services i.e. intangibility, perishability, simultaneity of production and consumption, and heterogeneity (Zeithaml et al., 1985) hinder the development and deployment of configurable services, although some conceptual analysis has been performed (Heiskala et al., 2006).

1.1 Practical Motivation

Services are often adapted according to properties of the customer, other stakeholders or related equipment. “One size does not fit all”. On the other hand, it is not realistic to fully customize for all customers. For example, fully customized insurance terms for each customer would call for uneconomical resources of insurance mathematicians, lawyers, etc. Similarly, high-volume telecommunications services such as business-to-consumer (B2C) mobile and broadband subscriptions cannot be individually modified for each customer as they must be deliverable through automatic platforms. Therefore a mass-customization approach is often desirable.

Companies today outsource ever more diverse functions but don’t want to spend time and effort in the process. Often full customization is optimal from the customer needs satisfaction point of view. But even customers may perceive fully customized solutions expensive and sub optimally accessible, potentially inconsistent and poorly documented. Further, the time and effort sacrifice in specification may be too much. For these reasons, mass customization may be a lucrative option for customers.

A theoretically promising means to achieve the benefits of mass-customization, service configuration, also has practical relevance and potentially wide applications in a number of industrial contexts. Contract based services are an interesting area to study this phenomenon, as opportunity to elicit customer requirements (Kujala, 2002) and observe customer behaviour may be better in a contractual customer relationship than in a one-off transaction.

1.2 Goals, Research Questions and Method

Many configurator vendors claim support for configuring services (Anderson, 2005), yet few examples of configurable services have been documented in scientific literature. Our long-term goal is to allow cost-effective, semi-automatic or even automatic mass-customization and individualization of services through the web by modeling and managing them as configurable service product families. In this study our research questions are:

(1) Can services be modeled and managed as configurable products?
(2) What can be varied in configurable services?
(3) What processes are related to configurable services?
(4) Do configurable services pose any special requirements on configurators and configuration modeling?

In this work we concentrate on services that are performed on the basis of a contract. We considered such services to potentially benefit most of the application of the configuration paradigm and configurator support.

We used qualitative case studies as our method, the four case companies are service providers participating in our 3-year research project on configurable services and their IT support. We have conducted empirical studies through participant observation and open semi-structured interviews in the companies. Further, we experimented modeling some of their service offerings using a configurator designed for physical goods.

Two cases are services offered by manufacturers of configurable equipment: industrial process equipment maintenance services, and information services of configurable heavy industrial equipment, both in business-to-business (B2B) setting. The third case involves insurance and other financial services, and the fourth case telecommunications services, both representing B2C offerings. The cases have some special service characteristics: The equipment related cases involve a significant goods dimension. The financial service company has a near maximal service dimension in their products. The telecommunications case has automated core service delivery.

2 Configurable Services

In this section we first discuss the nature of our case services, relate that to research question (1), and proceed to consider what is varied to answer the research question (2).

2.1 Modeling and managing services as configurable products?

In our case service offerings, it was possible to identify *service elements* that bear resemblance to components of physical products: more or less distinct parts of the service solution or another service element that provide some useful output. It was possible to vary the composition of service solutions in terms of included service elements. *Optional service elements* that can be included or left out were common and some mutually exclusive *alternative service elements* for roughly the same purpose were encountered. For example, the broadband connections included access to a specific bit rate connection, and had optionally available SMS-sending via Internet, and increased space for e-mail. An example of alternative service elements in broadband subscriptions was security. The customer could select no security or one of 3 alternatives: virus scanner, virus scanner + firewall, or virus scanner, firewall and spam + content filter. In maintenance services, assisting work-force for official inspections arranged by service provider is an optional service element. Some service elements were parametric, an example in the maintenance case was a guaranteed response time in case of a breakdown. It was possible to select it from 2, 4 or 8 hours.

The case services formed “service product families” where the individual members were similar but different in some respects. The general compositional structure was almost identical and same parameters applied to (most) members of the family. A specific service element can be always *included*, *available* optionally or as an alternative, or *not available* at all in some products or service elements. Each service product family contained major fixed service elements, typically the core service and some bundled additional service elements. For example, in our case ISP service products for consumers, speed and connection technology determined a product in the offering, e.g. 512kbit/s ADSL was considered one product, and 1 Mbit/s / 256 kbit/s Cable broadband was another product. Additional services such as e-mail, internet- news, and IRC services were included in all the products. Often more expensive service products included additional bundled service elements available for additional price or not available at all in lower-end service products. For example, a fast broadband connection included free access to an electronic phonebook that was not available in the slowest (and cheapest) connections. Similarly, applicable parameters and parameter domains sometimes changed by product or by service element. E.g., the availability of response times depended on the selected service product – the fastest response times were available only with the more comprehensive maintenance contracts, and the minimum availability of maintained equipment was not specified in a basic maintenance contract.

Configuration rules that are required for ensuring consistent product individual specifications were not common. A limited number of requires- or incompatible-relationships between service elements or characteristics existed. However, relationships of service elements or parameter values to customer

and/or equipment characteristics were common. For example, availability or pricing of some characteristic value depended on the properties of the related customer or other stakeholders. Further configuration rules resulted from suitability of a service product type or service element to specific types of a customer.

The above characteristics lead us to conclude that the described case service offerings can be considered as configurable products in the sense defined by (Tiihonen et al., 1997): Each solution is adapted to the individual needs of a customer, the offering has been pre-designed to meet a given range of different customer requirements, and each solution is specified as a combination of pre-designed service-elements (corresponding components or modules). Finally, there is no need to design new service elements as a part of the sales-delivery process.

2.2 Variation in Configurable Service Products

Based on our cases, service products can be varied on a broad spectrum of issues within a predefined envelope of variety. Following the characterizations of Dumas et al. (2001), we look at variation through the classical W's, including what, when, who, where, how, by whom, and why. A service element or parameter in a service can relate to several of these views. For example, a broadband connection must always be installed. Therefore selecting if a turnkey installation is performed affects both the what-view (the scope of service), and the who-view (who performs the installation).

2.2.1 What-variation

Often what-variation relates to the scope of the service: are some optional elements included or which of alternative scopes is selected. Some examples were given above. Further, insurance policies may vary on what is covered, against what risks, and on maximum coverage.

The what-view may also relate to pricing: what is included in the periodical fee, and what is charged on by-use basis. For example, maintenance contracts have a number of alternative amounts of repair work covered by a periodical fee.

2.2.2 When-variation

When-variation relates to the temporal aspects of a service or some of its elements. Such aspects include availability, pricing or response performance. For example, in the maintenance cases it was possible to include or exclude evening or weekend repairs in the base price. The temporal aspects may affect the whole service or only some of its elements. For example, in our maintenance case emergency services were available all the time, but depending on configuration decisions, regular repairs often had more limited temporal coverage.

When-variation can also relate to response-times. For example, in maintenance services it was possible to specify whether repair begins within 2, 4 or 8 hours after a breakdown has been reported.

2.2.3 With what? Who? How?

The human and physical resources used for a service and assignment of responsibilities to different stakeholders offer sources for variation. Further the way some service elements are delivered may be varied.

In our broadband case there were two main technologies for core service delivery – ADSL via telephone network and cable modems via cable network. These can be seen as configurable method for service delivery.

In the insurance case there was a budget-oriented car insurance product – related repairs were to be performed with third-party parts in a repair selected by the insurance company. In normal cases original were to be used and the insurance holder was able to decide where to repair the vehicle.

In our cases, by who-variation was related to the scope of service – the what-view. In other words, some element of the service may be assigned to the service provider or to the customer.

In our cases, reporting and payment were sources of with-what and how -variation. In maintenance

services it is possible to specify with what and how stakeholders are informed about major maintenance events. For example, e-mail and/or SMS can be sent to specified stakeholder(s) when a breakdown has been repaired. Billing could be configured to be electronic or regular paper-based, and payment to be regular or direct-debit.

2.2.4 To Whom –variation

The service recipient – be it a human or equipment- was always specified in our cases. A service product may have relations to a number of stakeholders that may or may not be explicitly defined. Actual variation of the service based on the to-whom view was less obvious in our cases. In some cases the delivery process was affected - e.g. security regulations required two service technicians instead of one to perform some tasks when the equipment to be maintained had specific properties. Further, some service elements or possible values of characteristics were targeted to specific segments or types of customers. In addition, the availability of some service elements may depend on properties of the customer and/or equipment. For example, all-inclusive maintenance contracts were not available for old equipment, and voluntary health insurance was not available to persons above a specific age.

2.2.5 Where –variation

Service delivery location may be a source of variation and have a significant effect on total customer sacrifice. It was possible to configure some training services to take place at customer premises or at service provider's premises. Large equipment is maintained on-site, but for smaller equipment a choice may be offered.

2.2.6 Why –variation

We did not encounter any explicitly why-view related sources of variation in the configurable service offerings. However, it was evident that reasons for buying a service solution affect the suitable solution.

2.3 Specific common sources of variation

In this subsection we discuss some sources of variation that may be present in many different types of configurable service products. These include pricing models, information and reporting, paying and billing, ownership and intellectual property rights, service quality attributes, and loyal customer benefits.

Pricing models for services and products are a complex phenomenon, a related body of literature has been analyzed e.g. by de Miranda (2005). We encountered three basic types of price elements: one-time, recurring (periodic), and pay-by-use. *Initiation price elements* are paid once, typically when the service contract is initiated. For example, telecommunications services often have an initiation fee. *Periodic price elements* such as monthly or yearly fees were common in our cases. *Pay-per-use price* elements were also common. For example, mobile phone calls may be charged by use.

Allocation of total service cost to different kinds of price elements varied significantly. In our case services initiation fees were relatively insignificant. Allocation to recurring and pay-per-use elements varied significantly. In minimal mobile subscriptions without bundled phone calls or other extras the periodic (monthly) price element was small and basically just covered that mobile services were available and billable. At the other extreme, periodic payments in insurance services covered the all service fees.

In our cases each service product had an associated pricing scheme that could be fixed or configurable. A pricing scheme contained a combination initiation, periodic and pay-per-use elements. Often different combinations of periodic and pay-per-use were offered –increased periodic payments included increased amount of use or offered reduced pay-per-use rates.

Sometimes a number of configurable service products differed significantly only in pricing. For example, some mobile subscriptions had a specific price when calling to the same service operator's

network, and a different price when calling to other networks. Another mobile subscription had the same rate to all networks. It was possible to configure these different service products to behave exactly the same way, except for pricing.

Information and reporting can offer significant value, or when performed poorly, significantly increase the total customer sacrifice. Here too, one size does not necessarily fit all. In our maintenance case, configurable notifications from service events helped the customer-side to be informed on the status, e.g. in case of equipment breakdown. The scope of information and reports available to customers via extranet was configurable. Even alarms on repair costs exceeding a pre-determined value or number of faults were available.

Paying and billing are also sources of variation. A configurable number of payments and due date offered extra value to some customers of our case companies. Bills were either standard paper-based or electronic, and payment options included e.g. direct-debit in addition. Detail level of billing itemisation (e.g. more detailed itemization of per-use charges) also offered configurable options. Further, some customers valued bills where a number of separate billing targets are billed simultaneously and information is grouped as desired.

Ownership and intellectual property rights (IPR) of information or intangible deliverables can be sources of variation. For example, who owns databases gathered in remote monitoring of equipment or detailed maintenance history? These were not configurable options in our cases, but at least in one company they have required case-specific negotiations.

Service quality attributes such as performance, dependability, security and safety can be sources of variation. For example, basic maintenance contracts did not guarantee availability while higher-end contracts included increasingly higher guarantees on availability. In a similar way, some temporal aspects such as how fast repair starts after a breakdown can also be considered quality attributes. The most obvious performance quality attribute was the broadband connection speed.

Various loyal customer benefits can be offered. One of our case companies offered a number of mutually excusive benefit programs.

3 Processes

In this section we discuss the processes related to our case services to answer our research question (3): What processes are related to configurable services? Again, we see a strong analogy to previous findings in configuration of physical goods (Tiihonen & Soininen, 1997).

3.1 Sales / specification process

Contract based services in our cases had a similar sales phase (specification phase) as configurable goods where the service along with it's price is specified. The configuration task produces a contract and possibly some non-contractual additional information elements.

Based on our mystery shopper experiences and interviews at our consumer market companies, and to some degree in maintenance contract sales, current sales processes have several challenges.

Sometimes the sales process tends to be product-centric. The persons at customer interface may start introducing and selling individual service products instead of analyzing the actual needs or requirements of the customer. For example, in a number of cases a potential customer who had made an appointment for comprehensive analysis of insurance-related needs was met with a clerk who started selling some specific insurance policy for a specific (assumedly) needed coverage.

Service product options considered less important by the person at customer interface may not be offered at all. For example, mobile subscriptions included a significant amount of optional value-added services of which only a small subset were offered.

Consultative mode of selling was felt desirable in at least two of our case companies. The idea is to find out relevant properties of the customer and other stakeholders, related equipment and environment as well-as needs to be able to recommend a suitable service solution. It was felt that this could alleviate some problems of product centric sales events.

Services for consumers were available through several sales channels while B2B maintenance and information services were sold only directly by the service provider. Service pricing to customers had little room for bargaining while the maintenance services were typically priced case by case. In telecommunications services and insurance services a contract proceeded automatically via IT support to delivery process (telecommunications service provisioning, insurance contract activation).

3.2 Reconfiguration

Managing reconfiguration seems to be more important in contract-based services than with most industrial goods. Long-term relationships between the supplier and customer are a norm. Often the service must be adjusted when customer needs, equipment, environment or other relevant aspects change. For example, in B2C telecommunications and insurance services systematic reconfiguration is common, and reconfiguration was considered a business requirement. Telecommunications customers subscribe to new additional services or change their subscription type. Insurance related needs change and insurance policies need to be updated to reflect these changes. Volumes were so high that automated reconfiguration support was needed, and a case company used a configurator with service reconfiguration support as a part of their ERP solution.

Management of reconfiguration may be easier in services than in goods, because the primary target of configuration is not a physical product individual. Therefore errors or inaccuracies in as-maintained configuration description, and condition of components are not as relevant. Optimization for maximally using old components is not necessary. Systematic “genuine” reconfiguration instead of project-based modernization requiring design may be possible more often. After a company changes its offering, it may be possible just to mass-update (map) old configurations to corresponding new ones in a way that makes reconfiguration within the new offering possible. Of course, this is not always the case, e.g. if the old configuration is not available in the new offering when some of the old elements are made obsolete.

3.3 Service delivery process

The service elements covered by a service contract may take place once, in discrete service events or continuously. In our cases service delivery process based on a single contract usually had repetitive discrete service events – “moments of truth”. These discrete service events can occur periodically with fixed periods (e.g. official inspections), periods determined by the customer and/or service provider (preventive maintenance based on a device-specific plan), or on demand (mobile phone calls). Some service elements such as turnkey installation of a broadband connection are performed only once. Insurance coverage or an always “open” broadband connection can be considered as continuous service delivery. Some of our case services included several types of delivery. For example, a broadband subscription user may also use value added services in discrete service events.

As discussed previously, configuration decisions may affect significantly the delivery process: e.g. what is done, when something is done, who manages or decides something, etc. Therefore information flows are important – service delivery process must act based on what was agreed in the specification phase. However, in one case we identified some significant parts of core service delivery process that were not affected by the service configuration decision, and could thus be performed without such information.

Service delivery processes of core services in our cases had very different natures. In telecommunications, configured services were made available (provisioned). After provisioning, service delivery was automatic – the customer can use the service at will using his/her equipment. Even provisioning was (almost) automatic. Routine maintenance was performed for the customer without any active customer participation: the service person often even used his/her keys for entry and performed the necessary actions without presence or activities of the customer. In insurance services, there is no actual service delivery ”if things go well”. Instead, there is just a promise to manage financial conse-

quences of specified harmful events.

As exemplified above in the maintenance and insurance cases, contrary to traditional service definitions, customer participation does not always take place. On the other hand, educational services of the other heavy industrial goods manufacturer and turnkey-installation of broadband subscriptions included "normal" customer participation and simultaneous consumption and production.

Customer participation and role can be directly or indirectly configured – a broadband user may perform the installation or participate in the turnkey installation process.

3.4 Development process

The development process of services was normally separate from individual deliveries in our case companies. When introducing new services, there may be overlap in development and delivery processes. In at least one company the difficulty of piloting new contract based services or features was pointed out due to long-term nature of commitments made.

We have no case experience in these cases on new service development. Therefore there is little we can say on how the companies define the appropriate offering – what variation to offer, and how they develop capabilities to sell, price and deliver them.

4 Applicability of configurators to services

In this section we consider the applicability of configuration modeling and configurators to services to answer our research question (4): Do configurable services pose any special requirements on configurators and configuration modeling?

4.1 Conceptual framework

Most of the 30 vendors studied in (Anderson, 2005) claimed their configurators supported services. Only two vendors described their modeling concepts and neither introduced any service specific concepts. No modeling examples were found.

We use the configuration ontology of Soininen et al. (1998) as a conceptual basis for analysing applicability of configuration modeling to services because it combines the major approaches for model-based configuration knowledge representation: *connection-based* (Mittal and Frayman, 1989), *resource-based* (Heinrich & Jüngst, 1991), *structure-based* (e.g. Cunis et al., 1989), and *function-based* (Najman & Stein, 1992) approaches. Our idea is to 1) verify that a relatively general ontology for configuration can indeed express the variability of service products, 2) and analyse which of the main constructs seem necessary in service context.

Configuration model knowledge is represented in configuration models that specify the set of *correct* configurations of a product with respect to the configuration model and requirements. The concepts of a *type* and an *individual* distinguish between the entities that occur in configuration model knowledge and configuration solution knowledge, respectively. A configuration can contain individuals of four different types: *component*, *port*, *resource* and *function*. In configuration models, these types are organized in a classification hierarchy in the usual manner. A subtype may refine inherited definitions in a restrictive manner. All these types can define attributes that parameterize or otherwise characterise the type.

A *component type* represents a distinguishable entity in a product that is meaningful for product configuration in the sense that a configuration is composed of *component individuals* of component types. Each component and function type can define its compositional structure through a set of *part definitions*. A part definition specifies a *part name*, a non-empty set of *possible part types* (*allowed types* for brevity) and a *cardinality* indicating the possible number of parts. The compositional structure is important for configuration because products are commonly described through their structure for design, manufacturing or maintenance purposes.

Component types can define usage and consumption of *resources*. The underlying idea is that some component individual(s) produce some resource and other component individual(s) use it. Resource

production and use must be either *satisfied*, in which case the quantity of resource produced must be equal to or greater than the quantity of the resource used or *balanced*, in which case the quantity of resource produced must be equal to the quantity of the resource used.

Topological concepts *port type* and a *port individual* represent how component individuals can be connected together to form a working product. Connections can be physical or logical. Port definitions effectively represent the compatibility of component individuals and specify the possible topologies of the product - the idea is that component individuals can be connected only if they have compatible interfaces. Some connections may be required to create a functional product.

Functions represent the functionality that the product individual provides to the customer, the user and the environment. Similar to components, they function types may specify attributes and compositional structure. However, resources and ports cannot be specified. The idea of functions is to provide a non-technical view to the functionality and features of the product to be configured. These are then mapped to component individuals, attribute values, and connections that implement the desired functionality and features.

Constraints are used for specifying the interdependencies of the individuals in a configuration, and their relations. A constraint is a formal rule, logical or mathematical or a mixture of these, which specifies a condition that must hold in a correct configuration. Constraints are a modeling mechanism that can be used when the other concepts are not suitable for capturing knowledge on some aspect of a product. A constraint language is used to construct constraint expressions from references to individuals, their properties and constants. These can be combined into complex expressions using relational operators and Boolean connectives.

The ontology does not cover knowledge related to geometry, pricing, optimality of configurations or knowledge needed during product development process. Neither does it cover the construction and control knowledge on how to accomplish the configuration task.

4.2 Modeling of configurable services with configurators designed for goods

Figure 2a illustrates the component-related concepts in a configurator implementation called WeCoTin (Tiihonen et al., 2003) whose modeling is based on a subset of the ontology – component types with attributes, part definitions, and constraints are included, functions, resources, and ports are excluded. WeCoTin was designed for configuring goods.

An example of modeling with WeCoTin (Figure 1): The component type `Car` has a part definition with part name `Engine`, allowed type `Motor, and cardinality 1`. The abstract component type `Motor` has concrete subtypes `Petrol18, Petrol20`, and `Diesel22`. `Car` also has a part definition with part name `GearBox`, allowed type `Transmission`, and cardinality 1. `Car` defines, out of the figure, a property with property name `Styling`, value type `string` constrained to values `"Standard"` and `"Elegance"`. In addition, `Car` specifies three constraints, shown in Figure 1c. `c1` specifies that `Engine of type Petrol18 and Styling "Elegance" are incompatible`, `c2` states that `Engine of type Diesel22 requires a GearBox of type Auto_transm, and c3 says that GearBox of type Auto_transm requires that Styling is "Elegance"`. A snapshot of an automatically generated user interface is shown in Figure 1b.

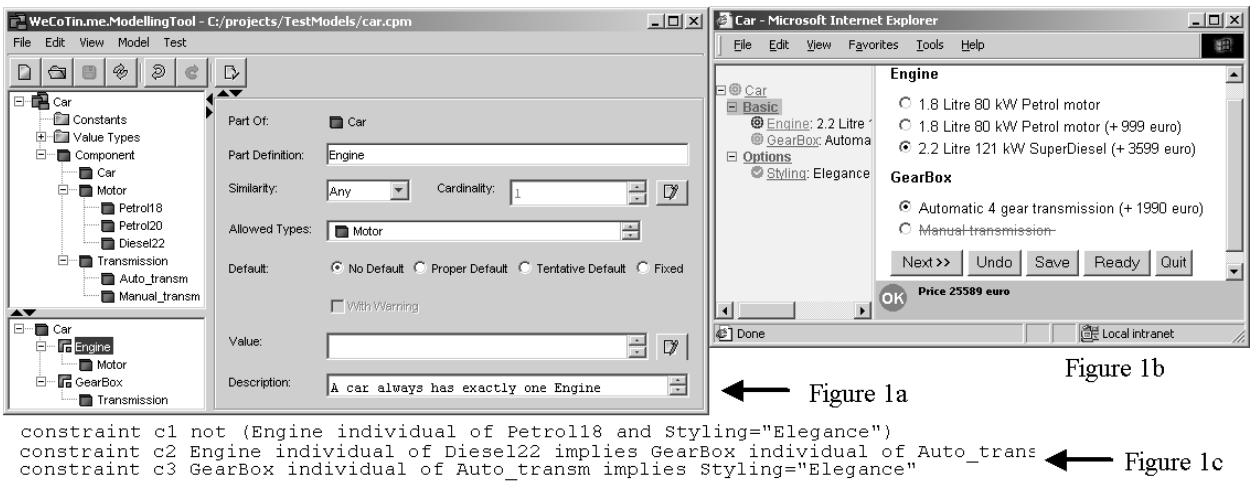

Figure 1. Configuration model of a Car (left) and the corresponding user interface (right)

We experimented modeling of broadband subscriptions (Anderson, 2005), maintenance contracts, mobile subscriptions as well as some insurance policies with WeCoTin configurator. The goal was to evaluate if existing real-world offerings can be modeled and configured, and to identify possible shortcomings. WeCoTin was to serve as an example of a modern configurator designed for configuring goods.

Modeling of contract-based service offerings as configurable products was possible without significant challenges. It was straightforward to model service elements as component types, some of which defined attributes. Optional and alternative service elements were modeled as allowed types in part definitions with cardinality 0 to 1 (or 1 with obligatory alternatives). No higher maximum cardinalities than 1 were encountered. However, the compositional structure was simple and shallow in our case products – service elements as part of the whole solution relatively seldom had further service elements as parts. Some service elements (and always the service solution) were parametric requiring attributes in modeling. Classification hierarchy and related refinement was useful – we often modeled different service products of a family as subtypes of a common supertype. Possible attribute values (domains), and sometimes allowed types of part definitions were refined to reflect different variation possibilities of the different members of the family. Because configuration rules required for ensuring consistent product individual specifications were not common there was little need for constraints that enforce them.

According to our previous modeling experiences of physical products, modeling aspects external to the product itself is not usually needed. However, in our service cases, the customer or other stakeholders and/or related equipment, environment, or their properties often had to be modeled to verify that some services, service elements or some values for their parameters are available or that they are priced appropriately. This resulted to component types that actually represented characteristics of corresponding stakeholders. Relationships were modeled as constraints.

Configuring a suitable or optimal service specification can be challenging although the “technical compatibility” of the solution itself was not a challenge. Recommendations and warnings would support the user in this task. We applied the soft constraint mechanism of WeCoTin (Pasanen 2003) to warn when some recommendations are not satisfied. However, we felt that such warnings were displayed too late –guidance towards the good solutions should be available in advance, not only after inadvisable selections have been performed.

We did not model prices of the offerings to constrain the required effort. However, it is important for customers to know how selections affect the price of the service. Instead of one price typical for goods configuration, our telecommunications case would require at least two – the initiation and periodical fees need to be kept separate. Further, it would even be useful to include estimates on amount of usage and related usage based prices, which would enable comparing the total cost of customership of different solutions. Optimization with respect to price could be useful for user to find optimally priced solutions given the requirements.

In some cases it seemed that modeling service delivery processes and resources in the sales phase would be beneficial to clarify the customer's role and to manage expectations. Another modeling requirement new to us was the need to assign different stakeholders as resources that participate in service events. Roles of stakeholders can vary e.g. due to different selections in what- or by whom-variation. This assignment can be modeled with attributes. Allocation of responsibilities to different, dynamically defined stakeholders could be modeled as connections to objects representing appropriate stakeholders. However, we feel that this is not enough to justify the need for ports and connections. We did not encounter any need for resource-constraint-type of modeling. Function or feature-oriented concepts could be useful when helping customers to select a suitable service configuration, or to configure on a higher level of abstraction. However, for direct modelling of the case offerings these were not needed. We did not address reconfiguration in our modeling experiments.

Based on our experiments and vendor claims we conclude that at least some configurable service offerings can be modeled and configured with traditional configurators. However, we felt a conceptual mismatch in modeling because thinking in components did not seem natural for services. Required scope of modeling is broader, because relevant stakeholders, equipment or environment must be modeled to verify availability or to determine pricing.

5 Previous Work and Discussion

In this section we first compare our results to previous work and then briefly discuss some of our findings.

Service configuration based on pre-determined specification options and/or delivery modules, possibly supported with configurators, has been at least a partial goal in several papers. Of these, configuration of maintenance services of industrial goods are discussed in (Meier et al., 2002; Dausch & Hsu, 2003), configuration of financial services in (Wimmer et al., 2003), and insurance in (Winter, 2001; Stolze et al., 2000), and customization of IT services in (Böhmann et al. 2003). Moreover, the ILOG JConfigurator has been used in financial services and insurance configuration (Junker & Mailharro, 2003) and telecommunications services have been configured with the CAWICOMS Workbench (Ardissono et al. 2003) and WeCoTin (Anderson, 2005). These papers support that services can be managed as configurable products in our case company service domains: financial, insurance, maintenance, and telecommunications services. Further, travel is a domain of interest in Torrens et al., (2002) and in Goy & Magro (2004). Combining services from pre-determined modules is suggested for IT consulting services in (Peters & Saidin, 2000). Service configuration in general has been discussed in (Akkermans et al., 2004; Heiskala et al., 2005) and a configurators intended for both physical and service products were described in (Bergenti 2004; Anderson, 2005). The work of Akkermans et al. (2004) has been applied in a case bundling energy services with broadband access (Baida et al., 2004).

Dimensions of service variation have been discussed by several authors. Different types and sources of variation in services and how to manage or limit their consequences in service delivery have been discussed by Harvey et al. (1997) and McLaughlin (1996) in service management literature. Their focus is on the management and structuring of the service delivery system and process whereas our focus in this work is on defining the dimensions along which configurable services specifications can vary. The non-functional properties of services have been discussed in (Dumas et al., 2001; O'Sullivan et al., 2002). Some identified properties such as rights to terminate the contract prematurely were not present in our cases - at least not as configurable characteristics.

The requirements for conceptual modeling of configurable services in configurators are discussed in (Heiskala et al., 2005; Akkermans et al., 2004). Both have a high-level process perspective that is new to configuration conceptualizations. Further, capturing the relevant customer characteristics is stressed in (Heiskala et al., 2005), a perspective also absent from previous work. In (Heiskala et al. 2006) the mainly goods-based product configuration literature has been reviewed for the benefits and challenges related to product configuration and configurators. The paper provides a conceptual analysis of whether the found issues are relevant in service settings.

Our cases did not offer who-variation on personnel attributes that deliver the service (e.g. qualifications or skills), or with-what characteristics of physical elements or equipment used in service delivery (e.g. quality or sophistication of equipment used). This was considered somewhat surprising as such examples are easy to find from other industries.

Why-variation was not present in the service specifications. Selecting a suitable specification could benefit from the why view, e.g. selecting a broadband subscription based on intended use and existing services can benefit from this. However, obtaining and understanding real customer needs can be difficult (Blecker et al., 2005).

6 Conclusions and Future Work

In this paper we discussed the phenomenon of configurable services from the point of view on service and process variability. Configurable services are one way to offer mass-customization of services. Similarly as in physical products, configurable services fill a gap between fully customized services (e.g. consulting projects and other professional services) and mass-services (e.g. electricity and other utilities for consumers or mass-transit).

We looked at some contract-based services where service delivery takes place on an ongoing basis based on a contract specified as a combination of pre-designed elements. The offerings of some of our case companies can be clearly considered as configurable.

Similar processes as in physical products can be identified in contract-based services. The development process is separate from sales (specification) and delivery based on such a specification. There is a separate specification phase where sales configuration takes place. Service delivery takes place repetitively based on a specification. Reconfiguration seems more significant but often easier than with most physical products.

Configuration modeling based on compositional structure, taxonomy, attributes and constraints can be used for modeling the service offerings of our cases. Our case services were easy to configure in the sense that there are few strict constraints on the service itself. However, there were many constrains on what services, service elements, or service characteristics are available or are suitable for customers and/or owned equipment (or their characteristics). There was little need for resource-based or connection-based configuration modelling. Modelling mechanisms like those described by Heiskala et al. (2006) could provide better conceptual match to service modeling than the ontology of Soininen et al. (1998) that we used as a reference of “traditional” model-based configuration modeling.

IT supported consultative selling could potentially offer significant benefits to some of our case companies. Adequate IT support for that must be able to deal with strict constraints, recommendations, and possibly optimization.

There are many fundamental subjects requiring further work in service settings. When service is configuration a viable business option? How to decide what variation to offer? Some of the metrics presented by Blecker et al. (2005) could provide answers. However, the metrics are geared towards goods and manufacturing. It should be studied if customer participation in production, lack of inventories, intangibility and other service characteristics influence the metrics. How to develop configurable services? How to modularize them? How common and severe are service configuration errors and their consequences in practice? How configurable services affect the way companies should organize themselves? How do intangibility, perishability, simultaneity of production and consumption, and heterogeneity of services (Zeithaml et al., 1985) hinder ability develop (and deliver) configurable services? For example, can the experience or personal interaction be configured due to potential variation caused by heterogeneity caused by personal properties of service delivery personnel?

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