SERVICE PROCESS MODULARIZATION:
REUSE VERSUS VARIATION IN SERVICE EXTENSIONS

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Abstract: In this study the authors integrate software engineering insights with research on service process design and product extensions to propose service process modularization as a way to influence customer adoption of service innovations. The authors conduct an experimental study to investigate customer response to reuse and variation of service processes in new offerings. Results of the study show that modularization increases perceived utility of a base service and likelihood of trial for new services, while the positive effect of service process modularization is contingent on the level of task complexity of the base service. Furthermore, expert customers prefer combined offerings that reuse familiar service processes, suggesting that practical considerations rather than variety are the main drivers of service utility and likelihood of trial.

Keywords: Service Process, Service Extensions, Modularization, Design, Innovation.
SERVICE PROCESS MODULARIZATION:

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A service-dominant logic (Vargo and Lusch, 2004) has led many firms to seek growth opportunities with services. The risks and failure rates of new initiatives, however, are high. For example, the recent major commercial launch of Nokia’s mobile music service in the United Kingdom generated only an estimate of 23,000 subscribers during its first six months (June, 2009). The challenges are not exclusive to high-technology industries or traditional goods industries. The road to innovation with services comes with no less duress for service firms.

Service-led growth is typically driven by reconfiguration of firm activities and added channels that enable customer activity (Bitner et al., 2000). For instance, on-demand mobile and Internet service channels are now commonplace in competitive industries (e.g., banking and airline travel) and are the central component of the service delivery strategy of many firms, such as Apple’s successful iTunes music store. A complex service system, however, increases resource demands for the firm and may overwhelm customers. Therefore, it is imperative to develop mechanisms that incorporate efficiency for the firm and simplicity for the customer as underpinnings of service growth strategies (Menor et al., 2002).

Some researchers (Meyer and DeTore, 2001, Sawhney, 1998) have suggested that platform thinking may be the key process that enables the creation of new activities and offerings. In practice, service development is made more demanding by the increasing complexities involved in providing a common service platform. This increased complexity has been resolved successfully by modularization of product design (Brownsword and Clements, 1996, Du et al., 2001, Robertson and Ulrich, 1998, Salvador, 2007). This approach has been especially effective in the engineering of complex artifacts. For instance, the design
and development of Chrysler’s PT Cruiser was driven by considerations of modularity in its interior elements and symmetrical instrument panel to accommodate right-hand drive conversion with a minimum of additional tooling (Cullen and Haller, 2004). The concept has been further developed in the software engineering literature where researchers have proposed detailed ways of designing software through reuse and variation of software code modules (Clements and Northrop, 2002, Pohl et al., 2005, Van der Linden, 2002). The basic premise of software engineering researchers is that reuse and variation of software code enables more efficient development of new versions of the software artifact (Rothenberger, 2003, van Ommering, 2005). This principle of modularization is relevant in the design of systems and processes of service delivery for service organizations. We posit that the fundamental driver of service process modularization is the ability to generate market impact efficiently through innovative market offerings characterized by reuse and variation of service processes.

The purpose of a strategy of modularization is also to influence the likelihood of new service adoption. Empirical generalizations in new product development indicate that radical innovations are generally characterized by slow uptake whereas incremental innovations may be faster (Ali, 1994, Dewar and Dutton, 1986), although with limited long-term impact (Banbury and Mitchell, 1995). There is limited evidence of whether consumer adoption of service innovations follows similar patterns (Rogers, 2003, Hauser et al., 2006, Moller et al., 2006). However, we expect that customers will be slow to adopt service innovations to the extent that such innovations are novel, involve behavioral change, and challenge the familiar customer schemata. These relationships may be moderated by perceptions of value. We propose that the impact of modularization on customer acceptance of a service innovation is contingent on the level of contact and task complexity in the base service.
In this paper we investigate one of the fundamental principles of service process modularization and its effectiveness for service development. We ground this paper on theory and research from cognitive psychology and service production to assess the customer response to service innovation propositions that follow the modularization principle. We investigate the likelihood of trial and utility of service extensions in an experimental study.

The rest of the article is organized as follows: In the subsequent section, we review the existing literature relevant to the notion of modularization and service extensions. Next, we develop a theoretical model and propose hypotheses for the evaluation of offerings that combine a base service with service extensions characterized by reuse versus variation of service process. These hypotheses are tested in an experimental study among a sample of the general population. Finally, the theoretical and managerial implications of the findings are discussed, followed by the limitations and avenues for further research.

LITERATURE REVIEW AND THEORETICAL MODEL

This research investigates the consumer response to service process modularization. Specifically, the effect of service process similarity on perceptions of utility and likelihood of trial is explored in offerings that combine base services of high versus low task complexity and service extensions characterized by reuse versus variation of base service processes. Principles of goal-derived categorization theory and service process design are relevant to the current research. We first review prior research in these areas. Subsequently, we propose a theoretical model with specific research hypotheses (see Figure 1).

--Insert Figure 1 about here--
Modularization and Service Extensions

Design reuse is a method used by companies to reduce cost and timing of new offerings (Ettlie and Kubarek, 2008). Some authors have suggested that design reuse can facilitate the development of new services. For instance, Meyer and DeTore (2001) conceptualized an implementation of service reuse through the development of reinsurance platforms and show the development of service offerings using a common framework. This implementation is also known as modular reuse (Baldwin and Clark, 2000), where components that make up a service or product are reused in the design of another service or product. It is apparent that a design reuse strategy can help to balance cost reduction and time to market. Nonetheless, the effect of such strategy on customer acceptance of service innovations deserves further exploration.

Research on brand extension has shown that the likelihood of transfer of knowledge and affect from a well-known, core brand to a new extension product increases with an increase in the perceived similarity between the two products (Aaker and Keller, 1990, Martin and Stewart, 2001). An appropriate measure of similarity is still a matter of debate. Nonetheless, Martin and Stewart (2001) have shown that goal congruency is an important factor in the organization of cognition and assessment of similarity. Perceived similarity, in turn, influences the likelihood of cognitive and affective transfer from one product to another. In line with this view, Thompson, Hamilton and Rust (2005) note that market research usually predicts that increasing product features will make products more appealing to consumers. The assumption underlying such prediction is that consumers infer functional product benefits from concrete product attributes and more benefits are equated with more value.

A complementary view (Gengler and Reynolds, 1995, Reynolds and Gutman, 1988) suggests that most abstract attributes are unrelated to concrete attributes, and abstract
attributes are more related to hedonic aspects of products (Snelders and Schoormans, 2004). Customers who are interested in utilitarian value are concerned with product (service) usage in an efficient and economic manner to achieve their goals. In turn, hedonic value reflects the product (or service) potential entertainment and emotional value rather than the achievement of any pre-specified objective (Dahr and Wertenbroch, 2000).

In a seminal article on service design, Shostack (1987) suggests that service production should be considered from the angle of process design. Shostack (1987) also suggests that two vital attributes of service processes are “complexity” and “divergence”. Wemmerlov (1990) questions the empirical validity of these attributes and suggests a taxonomy of “rigid” and “fluid” processes that integrates organizational views of technology embodied in activities performed by people and/or equipment to carry out certain tasks (Maister and Lovelock, 1982, Perrow, 1967). According to this view, the “service process” construct refers to both a process, which produces an intangible service and a process for which the service is embodied in a good for later consumption. Wemmerlov (1990) considers a number of process factors that are relevant in service production. Some of these have been well studied and include technology, service time, and flexibility (see, e.g., Cook et al., 2002, Ostrom et al., 2010). Customer-oriented process factors such as the degree of customer participation and the specification of customer’s role in the service process are increasingly relevant but have been less studied (Bendapudi and Leone, 2003).

Cognitive consistency suggests that fit between two product classes has a direct positive association with the attitude toward the extension (Aaker and Keller, 1990, Venkatesan, 1973). Consumers with positive associations are expected to be more willing to try new service propositions and vice versa. In the context of modularization, we expect fit to be higher for reuse than for variation of the customer role in the service process. Some consumers may be less willing to transfer their positive attitudes to a new service extension.
and need to be convinced that the new service is worth their effort, especially when the new service involves active customer participation in the production of the service (Bendapudi and Leone, 2003, Meuter et al., 2005). Thus, trial of the service extension is influenced by customer attitudes but it is also a value judgment. In a study of convergent products, Gill (2008) suggests that hedonic add-ons are more valuable than utilitarian add-ons. An alternative view (Bertini et al., 2009) suggests that the mere availability of add-ons enhances the value of a product as contextual cue of quality. In the Bertini et al (2009) study, non-alignable add-ons (e.g., a hedonic add-on to a utilitarian base) increase the utility of the base product, whereas alignable add-ons (e.g., a hedonic add-on to a hedonic base product) decrease the utility of the original product. We propose:

H1: A service extension characterized by **reuse** of the base service process has greater likelihood of trial than a service extension characterized by **variation** of the base service process.

H2: A combined offering of a base service and a service extension characterized by **reuse** of the base service process has greater utility than a combined offering that includes a base service and a service extension characterized by **variation** of the base service process.

**Task Complexity and Modularization**

Characteristics of the extension product class provide boundary conditions for the effect of the extension on customer attitudes. Several authors have emphasized the important role of customers in the service operation (Chase and Tansik, 1983, Stewart and Chase, 1999, Tansik and Smith, 1991) and the classification of Wemmerlov (1990) provides a useful
framework to differentiate service extensions regarding the customer role in the service process. According to Wemmerlov’s classification, rigid service processes can be characterized by low level of task variety, low level of technical skills required, low level of information exchange between the service system and the customer in order to create the service, and a process narrowly defined so that the service worker (or the customer) makes few judgmental decisions. At the opposite end of the spectrum there are fluid service processes characterized by high level of task variety, high level of technical skills required, high level of information exchange between the service system and the customer in order to create the service, and a process broadly defined so that the service worker (or the customer) often goes through un-programmed activities and makes several judgmental decisions.

Chase and Tansik (1983) shows that the degree of customer contact is an important dimension in the design of service systems and Soteriou and Chase (1998) shows a positive relationship between some of the customer contact dimensions and service quality. Soteriou and Chase (1998) uses a task analyzability construct as a proxy measure of Shostack’s service complexity to show that more complex services require more customer contact. This suggests that for complex services, a reduction in customer contact with the service system will affect negatively the quality of the service. Moreover, empirical evidence in new service development indicate that the likelihood of adoption of service innovations is strongly related to the degree of behavioral change involved and how well customers recognize and realize value (Michel et al., 2008).

High task complexity increases not only cognitive load but also psychological risk and search costs for the customer. This is particularly evident with customers who are less knowledgeable about the service process. Cognitive load may be reduced with intervention of service employees, but this is typically an adjustment made during service execution. We believe the adjustment can be anticipated in the design of service innovation by modular
reuse of service processes. Reusing a service process in a new service offering reduces customer anxiety associated with learning a new routine. As a result, customer attitudes towards the new service improve. Alternatively, modular variation in a service of high task complexity would increase the cognitive load and thus the level of challenge for the customer. This may not be a good adoption incentive for the average customer.

On the other hand, low task complexity equates to low involvement and in some cases mindless behavior from all participants in service production. In this case, the level of challenge can be increased with modular variation of service processes. The increased variety is associated with increased perceptions of value (Bharadwaj et al., 2009) and the novelty appeal would have a positive effect on customer attitudes towards the new service. Since modular reuse does not stimulate customer involvement, it may have a neutral effect on customer attitudes at best. We propose:

H3a: A service extension characterized by *reuse* of the base service process has greater likelihood of trial when the base service has *high task complexity* than when the base service has *low task complexity*.

H3b: A service extension characterized by *variation* of the base service process has greater likelihood of trial when the base service has *low task complexity* than when the base service has *high task complexity*.

H4a: A combined offering of a base service and a new service characterized by *reuse* of the base service process has greater utility when the base service has *high task complexity* than when the base service has *low task complexity*.
H4b: A combined offering of a base service and a new service characterized by variation of the base service process has greater utility when the base service has low task complexity than when the base service has high task complexity.

Earlier studies (Lovelock and Young, 1979, Schneider and Bowen, 1995) have shown that the quality of employees’ performance in a service delivery system has a positive impact on a firm’s productivity and service quality. Because customers are co-producers of the service, their efficiency influences the quality of the service process (Xue and Harker, 2002). Moreover, customer efficiency should increase by taking advantage of familiar service process (Cook et al., 2002). Not surprisingly, recent research (Meuter et al., 2005) has shown that not all customers are equal and certain readiness variables (i.e., customer role clarity, motivation, and ability) are key factors that influence the trial decision of service delivery systems that rely on the customer for the production of service.

Because customers, especially novice customers, are more comfortable with a familiar service script (Stewart and Chase, 1999, Tansik and Smith, 1991), knowing the script should facilitate service adoption. Concrete service system features are associated with service functionalities. Likewise, customers are able to determine action rules that are congruent with their mental representation of the service process. Experts should be quicker to adapt to a new process and appreciate service novelty. Moreover, experts have a better understanding of product related information and are better able to discriminate between important and unimportant features than novices (Alba and Hutchinson, 1987). However, whether experts perceive utility to be higher or lower than novices will also depend on the specific characteristics of the service and the outcomes they expect to achieve.

Customers with higher role clarity are therefore expected to be more willing to try new service propositions given their experience and tolerance for variety. Customers with
lower role clarity, however, need to be convinced that learning a variation of the known service process is worth their effort, especially when the new service process involves active customer participation in the production of the service. Thus,

H5: The effect of modularization strategy on likelihood of trial for a new service extension is mediated by role clarity.

PRETEST

Three base service categories were chosen for a pretest: primary health care, mobile text messaging, and video rental. The selected categories align respectively in a spectrum that covers from relatively high to relatively low levels of task variety and customer contact. Moreover, these service categories are popular and sufficiently competitive for a range of offerings that customers may be familiar with. After the selection of the base services and the sample, the objective of the pretest was to select combined offerings of base services and service extensions such that (1) one extension was associated with reuse of base service process and the other was associated with variation of base service process; (2) both extensions were congruent with the base service; and (3) both extensions and the base service could be used separately.

Our pretest comprised 90 undergraduate students (67.4% females, M_{age} = 20) who we randomly assigned to conditions. The study was conducted as three separate surveys (one each for each of the three service types), each of which were administered online. The study had a 3 (service type: health, mobile, video) x 2 (extension: reuse, variation) mixed design. We manipulated service type between-subjects and modularization within-subjects. Thus, each respondent evaluated one service type and the two proposed service modules as extensions. Participants first read a short description of the base service and rated their
familiarity with the service as well as their perceptions of level of customer contact and task variety. Next, they read a scenario describing, “one offering in the industry”, followed by a description of a new service extension (i.e., reuse or variation of base service process). Participants rated their perceptions of service process similarity, goal congruency, as well as the combinability and separability between the base service and the proposed extension. Next, they read a scenario describing, “another offering in the industry”, followed by a description of a new service extension (i.e., reuse or variation of base service process). Participants again responded to items of similarity, goal congruency, combinability, and separability. The order in which participants evaluated reuse or variation extensions was counterbalanced between subjects.

The participants responded to twelve single-item scales pertaining to the three base services and to the six extensions that were chosen as potential additions to these services. The six extensions were professional dental care and on-site health club (reuse and variation respectively for base service: primary health care), mobile payment and route planner (reuse and variation respectively for base service: mobile text messaging), and self-service kiosks and video on-demand (reuse and variation respectively for base service: video rental). We used single item scales for participants' familiarity with base service (from Mitchell and Dacin, 1996), level of customer contact, variety of tasks performed by customers, and variety of tasks performed by service personnel. For each service extension we used single item scales for similarity of service process and goal congruency with the base service (adapted from Martin and Stewart, 2001) as well as separability and complementarity (adapted from Aaker and Keller, 1990). All items used five-point scales.
Results

For the three base services, the reuse extensions were perceived more similar in process than the variation extensions (2.92 versus 2.43, t (89) = 3.35, p < .01). Across the board, the proposed service extensions did not differ in their perceived goal congruency (2.96 versus 2.81, t (89) = 1.09, ns), combinability (2.69 versus 2.67, t (89) = .158, ns), or separability (2.88 versus 2.82, t (89) = .419, ns) in relation to the base service. In addition to this analysis, we ran a series of 2 (extension) x 3 (service type) repeated measures ANOVA on each of the dependent variables process similarity, goal congruency, combinability, and separability to account for any effects of service type. There are no significant main effects of service type or significant interaction between service type and modularization for any of these variables.

On the basis of this pretest, we selected two base services (primary health care and video rental) and four extensions to correspond to the four conditions described in the theoretical model developed previously (see Figure 1). These conditions were (1) a professional dental care service extension to primary health care (process reuse for a high complexity service); (2) an on-site health club service extension to primary health care (process variation for a high complexity service); (3) a self-service interactive kiosk extension to a video rental shop (process reuse for a low complexity service); and (4) a video on-demand service extension added to video rental (process variation for a low complexity service). See appendix for detailed service scenarios.

MAIN STUDY

The main study comprised a sample of 289 participants (51.9% females, M<sub>Age</sub> = 49, M<sub>Income</sub> = $58,000) who we randomly assigned to conditions using a 2 (extension: reuse, variation) x 2 (service task complexity: low, high) between-subjects design. We conducted
the study with a representative sample provided by a market research firm that has a panel of respondents who participate in online surveys for cash incentives. The study was programmed in one survey with four randomized conditions and administered online using Inquisit Web and invitations were sent by e-mail to a randomly selected pool of panelists from the database. Each panel member was provided with a unique ID and password, and members were not allowed to complete the survey more than once. The survey was administered until 300 completed responses were obtained. The completed surveys were collected in approximately one week and it was removed after the desired sample was obtained. Of the 300 participants, 11 surveys were discarded because of incomplete responses, resulting in 289 completed surveys. According to the firm’s policy, people who completed the survey were randomly awarded cash incentives for their participation.

Procedure

Each participant evaluated one scenario. The participants were randomly assigned to one of the four scenarios on the basis of the 2 (extension: reuse, variation) x 2 (service task complexity: low, high) study design. The survey protocol was similar to the pretest. Participants first read a short description of the base service and rated their expertise with the service as well as their perceptions of level of customer contact, task complexity, utilitarian and hedonic value of the service. Next, they read a scenario describing, “one offering in the industry”, followed by a description of a new service extension (i.e., reuse or variation of base service process). Participants rated their intention to try the new extension and their perceptions of role clarity regarding the new extension. They also rated service process similarity, combinability and separability between the base service and the proposed extension. They then responded to questions regarding the utility and incremental value
(utilitarian and hedonic) of a combined offering that would include both the base service and the proposed extension. Finally, the participants’ demographic information was collected.

**Dependent variables**

Our dependent variables are *likelihood to try the service extension* and *perceived utility of the combined offering*. We measured likelihood of trial with the question, “How likely would you be to try [the new service]?” We measured perceived utility of the combined offering using six items (bad/good, unlikable/likable, not useful/useful, low/high quality, undesirable/desirable, unfavorable/favorable) from Peracchio and Tybout (1996). Another dependent measure used for mediation analysis was the perceived incremental value of the combined offering, compared with the base service without the new extension. We measured two dimensions of value: *hedonic* and *utilitarian*. Hedonic incremental value of the combined offering was assessed with two items (much more fun/much less, much more exciting/much less), and utilitarian value with two items (much more helpful/much less, much more practical/much less) from Voss, Spangenerberger and Grohmann (2003). All items used 11-point scales.

**Other variables**

We measured service expertise with three items adapted from Mitchell and Dacin (1996), and task complexity with the five-item scale developed by Soteriou and Chase (1998). We measured the perceived utilitarian and hedonic value for the base service with two-item scales adapted from Voss, Spangenerberger, and Grohmann (2003). Role clarity, regarding the proposed extension, was measured with four items adapted from Meuter et al (2005). Process similarity between the base service and the proposed extension(s) was measured on three-item scales adapted from Martin and Stewart (2001). Substitutability and
Combinability of the base service and extension(s) were measured on the same scales used in the pretest. These measures were used in the manipulation checks and in other analyses.

**RESULTS**

Reliability for expertise, task complexity, role clarity, similarity, and utility ranged from .76 to .96. To assess the construct validity of our scales, we ran a confirmatory factor analysis. A five-factor model indicated an acceptable goodness of fit and significant loadings for each observed variable in their respective latent factor (all $ps < .01$). We averaged the scales for subsequent analyses.

**Manipulation Checks**

Consistent with the pretest, the reuse extensions were perceived more similar in process than the variation extensions (5.81 versus 4.74, $t(287) = 5.04, p < .01$). The task complexity manipulation was also appropriate: primary health care is perceived to have higher task complexity than video rental (4.46 versus 6.44; $t(287) = 9.59, p < .01$). For the two service contexts, the three manipulation criteria were met. First, one extension was associated with reuse of base service process and the other was associated with variation of base service process. Second, both extensions were congruent with the base service. And third, the two service contexts used in the study were perceived to be at different levels in the spectrum of high versus low task complexity.

**Effects on Dependent Variables**

Table 1 shows the means of the dependent variables across conditions. A 2 ($modularization$) x 2 ($service complexity$) ANCOVA on likelihood of trial of the new service

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1 In the Soteriou and Chase (1998) scale lower values indicate higher task complexity.
extension with expertise as a covariate showed a significant main effect of modularization (F(1, 284) = 12.27, p < .01), indicating that likelihood of trial of the new service is greater when the proposed extension is a reuse of the base service process (M_{Reuse} = 6.29, M_{Variation} = 5.10). There was also a significant main effect for service type (F(1, 284) = 12.27, p < .01), suggesting that likelihood of trial is more likely for the service of high complexity (M_{Health} = 6.23, M_{Video} = 5.15). Thus, there is support for H1. Furthermore, the interaction between modularization and service type on likelihood of trial was significant (F(1, 284) = 5.75, p < .05), indicating a decrease in consumer attitude for the variation extension that is stronger for the service of high task complexity. The effect of expertise on likelihood to try the new service was significant (F(1, 284) = 45.63, p < .01), indicating that likelihood of trial increases with customer expertise.

---Insert Table 1 about here---

A 2 (extension) x 2 (service complexity) ANCOVA on incremental utilitarian value with expertise as a covariate showed no significant main effect of modularization (F(1, 284) = 1.20, ns). There was, however, a significant main effect for service type F(1, 284) = 5.93, p < .05), suggesting that incremental utilitarian value of the combined offering is higher for the service of high complexity (M_{Health} = 6.39, M_{Video} = 6.11). The interaction between modularization and service type on incremental utilitarian value of the combined offering was also significant (F(1, 284) = 4.90, p < .05), indicating a choice reversal for the modularization strategy proposed in both service contexts. The effect of expertise on incremental utilitarian value was significant (F(1, 284) = 46.38, p < .01). A 2 (extension) x 2 (service complexity) ANCOVA on incremental hedonic value with expertise as a covariate showed no significant
effects for modularization or service type. Although it appears that variation increases hedonic value, the effect is not statistically significant.

A 2 (extension) x 2 (service complexity) ANCOVA on utility of the combined offering with expertise as a covariate showed no significant main effect of modularization (F(1, 284) = 1.27, ns) and a marginal effect for service type (F(1, 284) = 3.57, p<.10). Thus, H2 is not supported. There was, however, a marginal interaction effect between modularization and service type on utility of the combined offering (F(1, 284) = 3.45, p<.10), indicating a choice reversal between reuse and variation extensions. Such reversal is stronger for the service of high task complexity (M_{Reuse} = 6.75, M_{Variation} = 6.06). The effect of expertise on utility of the combined offering was significant (F(1, 284) = 36.99, p<.01), indicating that service utility increases with customer expertise.

Reuse of Base Service Process

It was proposed that a service extension characterized by reuse of the base service process would have greater likelihood of trial when the base service has high task complexity than when the base service has low task complexity (H3a). Accordingly, a combined offering that includes a reuse extension would have more utility when the base service has high task complexity than when the base service has low task complexity (H4a). H3a was supported. Specifically, likelihood of trial was greater for dental care (base service: primary health care) than for self-service kiosks (base service: video rental) (7.09 versus 5.50; t(152)=3.22, p<.01). H4a was also supported. Utility was higher for health + dental than for video rental + self-service kiosks (6.66 versus 5.97; t(152)=1.97, p<.05). It was proposed that this effect was due to the enhancing effect of the service process reuse on the increased efficiency of using the service. Customer efficiency improvements would have more impact in services of high task complexity.
Variation of Base Service Process

It was also proposed that for services of low task complexity, a new service extension characterized by variation of service process would have greater likelihood of trial than adding a reuse extension (H3b). Accordingly, a combined offering that includes a variation extension would have more utility than that with a reuse extension (H4b). Our results show that the effects are in the expected direction, but not sufficiently strong to support the hypotheses. Specifically, there were no significant differences in likelihood of trial for video on-demand service (base service: video rental) than for health club (base service: primary health care) (5.31 versus 4.93; t(133)=.68, ns), or Utility for video rental + video on-demand versus primary health care + health club (6.25 versus 5.89; t(133)=1.08, ns).

Mediation of Role Clarity

Finally, we proposed that role clarity would mediate the effect of modularization on likelihood of trial (H5). Regression analyses revealed that modularization had a significant effect on likelihood of trial ($\beta= 1.19$, SE = .37, $t = 3.20$, $p<.01$). When both modularization and role clarity were used as predictors for likelihood of trial the coefficients were as follows: $\beta =.68$, SE =.33; $t =2.07$; $p<.05$; and $\beta= .62$, SE =.06; $t =9.62$; $p<.01$. The Sobel test revealed a significant mediation effect of role clarity for likelihood of trial (test statistic = 2.64, $p <.01$). H5 was supported.

GENERAL DISCUSSION

This experimental study (conducted with a representative sample of the target market) supported the theoretical model in Figure 1. The modularization scenarios increased perceived service utility for both base services. There are, however, asymmetric effects in
their contribution to customer value. Thus, modularization will have a positive customer response, but this is contingent on service type and customer role clarity, as predicted.

Our findings show that for a base service of high task complexity a service extension characterized by reuse of the base service process has greater likelihood of trial than a service extension characterized by variation of the base service process. Likewise, a combined offering of a base service and a new service characterized by reuse of the base service process has greater utility than adding a new service characterized by variation of the base service process. Moreover, a service extension characterized by reuse of the base service process has greater likelihood of trial for a service of high task complexity than for a service of low task complexity.

Reverse effects are found for service extensions characterized by variation of the base service process. That is, for a base service of low task complexity a service extension characterized by variation of the base service process has greater likelihood of trial than a service extension characterized by reuse of the base service process. Likewise, a combined offering of the base service and a new service characterized by variation of the base service process has greater utility than adding a new service characterized by reuse of the base service process. Moreover, a service extension characterized by variation of the base service process has greater likelihood of trial for a service of low task complexity than a service of high task complexity.

Furthermore, consistent with our expectations, expertise significantly increases perceptions of value. Expertise does not, however, influence the direction of the modularization effect. On average, participants prefer combined offerings that reuse known service processes, suggesting that a desire for practicality is driving decisions more than a desire for variety. Such preference, however, is contingent on the perception of task complexity for the base service. Specifically, it was shown that in the case of a service of
high task complexity, adding a reuse extension was valued more than adding a congruent, variation extension (e.g., a combined offering of health care + dental had greater utility than a combined offering of health care + health club), whereas for low task complexity services, adding a reuse extension was valued less than a variation extension (e.g., a combined offering of video rental + self-service kiosks had lower utility than a combined offering of video rental + video-on-demand).

**Theoretical Implications**

The study makes several contributions to the literature. First, the study advances the conceptualization and empirical testing of the reuse/variation principle of service modularization for the service innovation literature (see, e.g., Baldwin and Clark, 2000, Ettlie and Kubarek, 2008, Salvador, 2007). The study builds on established concepts in the software engineering literature (Böckle et al., 2002, Pohl et al., 2005, Van der Linden, 2002, van Ommering, 2005) to develop a novel way to conceive service innovations.

Second, findings from this research advance a framework for service development that considers the role of service process similarity in service development. There have been previous calls for new insights into service process design (e.g., Menor et al., 2002, Cook et al., 2002). Such calls have been renewed recently (Ostrom et al., 2010). Current service development approaches, however, do not incorporate the service modularization concept well (see, e.g., Menor et al., 2002) (Chai et al., 2005, Zomerdij and Voss, 2010). The proposed use of service process reuse and variation will lead to more systematic development of service platforms envisioned earlier by Sawhney (1998) and Meyer and DeTore (2001).

Third, the research in the current article reaches across disciplines, from consumer research to the engineering literature to provide new insights into the development and execution of new service processes. The adoption of modularization in software engineering
has changed the business models of the industry towards product “line” and product “family” thinking. Stuart and Tax (2004) have called for an integrative, holistic service design approach, which would tie together all the areas needed for designing a successful service. The adoption of service modularization could lead towards this goal by incorporating more formal ways to develop and manage service lines or families. This may be especially important in the development of information technology enabled services and smart services, where service design and software development meet.

Fourth, the study provides insights that enhance service design by demonstrating the mediating role of service task complexity in the customer response to modularization strategies. This is a useful conceptualization that needs to be considered in service design studies, and provides some initial answers to the question of how to use service design in influencing customer behavior in service systems (Ostrom et al., 2010). The study also reinforces a much needed emphasis on customer activity variables, such as role clarity, and the need to incorporate customer scripting and mental action rules in service design (see, e.g., Stewart and Chase, 1999, Tansik and Smith, 1991).

Finally, this study also adds to the literature on service value (Ramirez, 1999, Vargo and Lusch, 2004). More specifically, results of the study draw attention to a distinction between utilitarian and hedonic perceptions of value with service extensions. Findings suggest that customers derive increased utilitarian or hedonic value to the extent that service extensions propose either reuse or variation of familiar service processes. Thus the value perceptions of the service users should play an important role when deciding how to balance reuse and variation of service processes through service modularization. More importantly, this distinction of service value perceptions should be incorporated in the development of new service design methods so that these would provide guidance for researchers on how to facilitate consumer adoption of innovations in different service contexts.
Managerial Implications

Findings of the study have several important implications for practitioners. First, the study shows that using process modularization to frame service innovations increases both the likelihood of trial of the new service and the perceived value of the combined offering that includes the base service and the new service. Therefore, service designers can expect the principle of service process reuse and/or variation to return higher perceived utility and likelihood of trial. We also demonstrate that services that are characterized by high task complexity can create more value with modular reuse. On the other hand, services that are characterized by low task complexity can create more value with modular variation. Software engineering studies promote the use of modularization for its efficiency gains in project development. Although the current study does not address this aspect of service modularization, we expect new service development to share some of the argued efficiency gains demonstrated in the software development literature (Pohl et al., 2005).

Second, findings from the study indicate specific ways to apply the concepts of service process reuse and variation in service design. We found that service process variation adds more value to low task complexity services regardless of contact level and customer participation in service production. One possible explanation to this finding lies in the role of variety and customization of the service to increase perceived value for the customer. Furthermore, we found that service process reuse adds more value to services of high task complexity regardless of contact level and customer participation in the production of the service. A likely explanation for this finding is the increased customer efficiency derived from using known service scripts.

Finally, insights from the study enable managers to develop service platforms (Meyer and DeTore, 2001, Robertson and Ulrich, 1998), and service families of different service lines in line with well established approaches in software product management (see, e.g.,
Böckle et al., 2002, Van der Linden, 2002). The study indicates that overall expert customers value modularization more than novices. According to our predictions, experts are quicker to adapt to a new service script and value novelty more than novice customers. This has important implications for the development of service platforms for specific customer segments and indicates ways to anticipate a roadmap of customers’ expectancy of service features. Thus, service designers can potentially use versioning strategies similar to software releases, that is, releasing different versions of the service for customer segments with varying expertise levels. Such strategy facilitates the engagement of expert customers while providing less challenging offerings to engage novice customers.

**Limitations and Directions for Future Research**

The current study investigates the consumer response to reuse versus variation of service process. Future research needs to test combined offerings that include both reuse and variation and examine possible interactions. Such research would bring useful insights to advance service platform thinking as well as the use of modularization in both service design and development processes and work practices. More research is also need to advance our initial insights into the duality of value (i.e., utilitarian versus hedonic) perceived in such service extensions.

Another angle of the current study is the examination of modularization in the context of high task complexity services versus low task complexity services. More studies are needed to investigate the usability of service modularization in other service contexts. A first step could be to contrast scenarios or service prototypes within both fluid and rigid service processes to corroborate our findings. This will help us to further refine the notion of reuse/variation as pillars of a service modularization strategy. Future research also needs to examine the framework with other types of services, especially smart services that represent
an alternative conceptualization of service process. In addition, it would be valuable to examine alternative ways to modularise. For instance, a components-based approach to modularization is emerging as the dominant strategy in the software engineering literature (see, e.g., Pohl et al., 2005). Such approach suggests interesting research avenues to increase creativity in service design.

Overall, our research advances knowledge in the area of service design and development and provides managers with a systematic approach to mitigate usability and market risks associated with service development and service expansion. We welcome other researchers to join us in understanding the role of modularization in service design, service development processes and work practices.

REFERENCES


FIGURE 1

CONCEPTUAL MODEL AND HYPOTHESES

Service Task Complexity: Low versus High

H3a,b (H4a,b)

Service Process Modularization: Reuse versus Variation

Hr (H5)

Customer Role Clarity - Service Extension

Customer Likelihood of Trial – Service Extension

(Utility – Base Service + Service Extension)
### TABLE 1

**EFFECTS OF MODULARIZATION ON DEPENDENT VARIABLES**

<table>
<thead>
<tr>
<th>Process Modularization</th>
<th>Service Type</th>
<th>Likelihood of Trial</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reuse</td>
<td>Low Task Complexity</td>
<td>5.50&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.34)</td>
<td>(2.23)</td>
</tr>
<tr>
<td></td>
<td>High Task Complexity</td>
<td>7.09&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.66&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.76)</td>
<td>(2.05)</td>
</tr>
<tr>
<td>Variation</td>
<td>Low Task Complexity</td>
<td>5.31&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.25&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.27)</td>
<td>(1.71)</td>
</tr>
<tr>
<td></td>
<td>High Task Complexity</td>
<td>4.93&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.89&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.08)</td>
<td>(2.10)</td>
</tr>
</tbody>
</table>

Notes: Standard deviations are in parentheses. Different superscripts in the same column indicate that the difference between means is significant ($p<.05$).
APPENDIX A: SERVICE SCENARIOS

LOW TASK COMPLEXITY – BASE SERVICE: A traditional video rental service allows customers to obtain movies in DVD for a specified period of time in exchange for payment. Typically, a rental shop will conduct business with customers under conditions and terms agreed upon in a contract. Typically, a customer must sign up for an account with the shop and give billing information like a credit card number. If DVDs are returned late, the shop usually charges late fees, which typically accumulate day by day.

PROCESS REUSE: One offering in the industry is the vending of DVDs via self-service/interactive kiosks. Self-service kiosks are typically located in fast food restaurants, pharmacies, grocery stores, and convenience stores. The typical self-service vending kiosk combines an interactive touch screen and sign, a robotic disk array system, and web-linked electronic communications. Kiosks typically hold more than 600 DVDs with 70-200 titles, updated weekly. DVDs can be returned the next day to the kiosk. If DVDs are returned late, the kiosk vendor usually charges late fees, which typically accumulate day by day.

PROCESS VARIATION: One offering in the industry is video on demand (VOD) systems, which allow customers to select and watch video content on demand. VOD systems either stream content through a set-top box, allowing viewing in real time, or download it to a device such as a computer, digital video recorder, or portable media player for viewing at any time. Some providers offer both VOD streaming, such as pay-per-view, whereby a customer buys or selects a movie and it begins to play on the television set almost instantaneously, or downloading to a digital video recorder rented from the provider, for viewing in the future.
HIGH TASK COMPLEXITY - BASE SERVICE: A clinic (or an outpatient clinic) is a small private or public health facility that is devoted to the care of outpatients, often in a community, in contrast to larger hospitals, which also treat inpatients. General practice clinics are run by one or more general practitioners and provide primary health care. Some clinics function as a place for people with injuries or illnesses to come and be seen by a nurse or other health worker. In these clinics, the injury or illness may not be serious enough to warrant a visit to an emergency room, but the person can be moved to one if required.

PROCESS REUSE: One offering in the health industry is professional dental care. Professional dental care services are performed by dentists and dental hygienists and include the treatment of many different dental/oral disorders as well as surgical procedures such as dental implants. Typical services include routine examination of the teeth by a dental professional, cleaning, taking of prescribed radiographs, dental sealants, and instructions for proper dental care.

PROCESS VARIATION: One offering in the health industry is health clubs. A health club (commonly referred to as a gym) is a place that houses exercise equipment for the purpose of physical exercise. Most health clubs have a main workout area with free weights and exercise machines, and a cardio area, which includes many types of cardiovascular training-related equipment such as stationary exercise bikes, elliptical trainers and treadmills. Most health clubs offer group exercise classes that are conducted by qualified fitness instructors. Such classes are typically based on aerobics, cycling, yoga, Pilates and muscle training.
**APPENDIX B: SCALES USED IN MAIN STUDY**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Alpha</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expertise</td>
<td>.92</td>
<td>3 items from Mitchell and Dacin (1996)</td>
</tr>
<tr>
<td>Task Complexity</td>
<td>.88</td>
<td>5 items from Soteriou and Chase (1998)</td>
</tr>
<tr>
<td>Utilitarian Value</td>
<td>(r = .79)</td>
<td>2 items from Voss, Spangenger, and Grohmann (2003)</td>
</tr>
<tr>
<td>Hedonic Value</td>
<td>(r = .86)</td>
<td>2 items from Voss, Spangenger, and Grohmann (2003)</td>
</tr>
<tr>
<td>Role Clarity</td>
<td>.92</td>
<td>3 items from Meuter et al (2005). Original scale has 4 items and one was dropped in this study.</td>
</tr>
<tr>
<td>Service Process Similarity</td>
<td>.76</td>
<td>3 items adapted from Martin and Stewart (2001)</td>
</tr>
<tr>
<td>Service Utility</td>
<td>.96</td>
<td>6 items from Peracchio and Tybout (1996)</td>
</tr>
<tr>
<td>Incremental Utilitarian Value</td>
<td>(r = .91)</td>
<td>2 items from Gill (2008), adapted from Voss, Spangenger, and Grohmann (2003)</td>
</tr>
<tr>
<td>Incremental Hedonic Value</td>
<td>(r = .94)</td>
<td>2 items from Gill (2008), adapted from Voss, Spangenger, and Grohmann (2003)</td>
</tr>
</tbody>
</table>