

# Examining the link between service modularity and firm performance: A capability perspective

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# **Examining the link between service modularity and firm performance: a capability perspective**

## **Abstract**

**Purpose-** While service scholars have generally supported the idea that service modularity enhances firm performance, the literature offers very little evidence of the actual process through which service modularity continuously contributes to firm performance. This study draws from a capability perspective to examine the link: service modularity capabilities—service modularity—new service advantage—firm performance, as well as the moderating role of radical innovation capability in the effect of service modularity on new service advantage.

**Design/methodology/approach-** To examine this link, data were collected from a cross-industry survey of 231 leading service firms. Structural equation modeling and hierarchical moderated regression analyses were employed to test the model.

**Findings-** Analyses reveal that new service advantage mediates the service modularity—firm performance relationship. Moreover, service modularity capabilities act in an important antecedent role to configure service modularity. Among the findings, it is worth emphasizing that radical innovation capability not only strengthens the positive effect of, but also alleviates the negative effect of, service modularity on new service advantage.

**Originality/value-** This study provides a more complete understanding of how service modularity enhances firm performance by discovering the hidden role of new service advantage that bridges service modularity and firm performance, clarifying the role of service modularity capabilities in configuring service modularity, and confirming the important role of radical innovation capability in sustaining the effectiveness of service modularity.

**Keywords** Service modularity, Service modularity capabilities, New service advantage, Radical innovation capability

**Paper type** Research paper

## 1. Introduction

Service innovation has been described as one of the most important issues in the service industry (Andreassen *et al.*, 2015). Although service scholars agree that new service development (NSD) is one of the crucial processes for achieving a superior service innovation, the risks and failure rates of NSD are particularly high (Tuunanen and Cassab, 2011). This dilemma has driven managers to search for various NSD strategies which include servitization (Baines *et al.*, 2009), business process modeling notation (Milton and Johnson, 2012), service business model innovation (Visnjic Kastalli and Van Looy, 2013), or service blueprinting (Bitner *et al.*, 2008). Service modularity has recently emerged as a potential solution to NSD (Voss and Hsuan, 2009; Ulkuniemi and Pekkarinen, 2011).

Service modularity refers to the design of a new service that combines different service components through interfaces (Pekkarinen and Ulkuniemi, 2008). We use this definition as a basis for the present paper in a dynamic and measurable way because we need a measurable construct of service modularity. Therefore, service modularity as meant in this study is the degree of the modularity of the service offered. The service component is considered as the smallest unit, offering one service characteristic, while an interface keeps the two service components together by providing common rules. Here, service component refers to an element constituting a service. An interface refers to a point where two service components connect (Chai *et al.*, 2012). A practical example of service modularity is that, previously, not many airlines were willing to offer online services for booking plane tickets. Nowadays, many companies have combined two service components, such as purchasing plane tickets and booking car rental reservations, in one module, thereby providing a new service for customers, which increases firms' competitive advantage and also improves the effectiveness of firms' performance. Table I presents some examples of service modularity.

**Insert Table I here**

As firms are designing and offering new services in a modular approach, academic research into service modularity has also begun (see Table II). Previous studies have looked into the relationship between service modularity and performance (Bask *et al.*, 2011; Voss and Hsuan, 2009; Lau *et al.*, 2011), with general support for the idea that service modularity enhances firm performance (e.g., Gentry and Elms, 2009; de Blok *et al.*, 2010; Rahikka *et al.*, 2011). However, despite the importance of service modularity to firm performance, the existing literature offers very little insight into the internal process and thereby leaves us in the dark regarding how service modularity actually contributes to firm performance. In addition, little is known about the characteristics of successful programs for building service modularity. Furthermore, our knowledge of how a firm sustains the effects of service modularity on firm performance is not well understood. Such insights are critical to managers who wish to manage service modularity to enhance NSD outcomes.

### **Insert Table II here**

We address these issues by using the capability perspective. This is because, based on the capability perspective, Ketchen *et al.* (2007) argue that organizational resources only have potential value. Helfat and Winter (2011) suggest that a firm's ability to configure organizational resources through organizational capabilities is more crucial than the organizational resources helping the firm achieve desirable performance. Sirmon *et al.* (2011) propose that it is a firm's competitive advantage that drives performance. Taken together, since service modularity (as a resource) and performance may not be directly related, it is important to investigate the potential moderating impact of competitive advantage on the process during which service modularity affects firm performance. In addition, since an organizational capability has the ability to integrate, build, and reconfigure internal and external resources to

create a competitive advantage (Teece *et al.*, 1997), it is important to empirically explore the notion that organizational capability enables a firm to continuously reconfigure its service modularity in our study. Finally, since firms have the tendency to overuse service modularity (Tuunanen and Cassab, 2011), we propose that the effectiveness of service modularity may not be linear. To sustain the effect of service modularity, a firm must develop its organizational capability that is expected to be beneficial for its service modularity reconfiguration process.

Using a cross-industry analysis of 231 service firms, we expect this study to contribute to service modularity and capability literature by offering a deeper understanding of the service modularity—firm performance relationship, and by providing new insight for managers as to how firms' resources should be allocated in order to build, configure, and sustain the greatest effectiveness of service modularity.

In the following sections, theoretical background and hypotheses development are discussed. The research design is then presented, followed by the results of the empirical study. This study concludes with a discussion and implications for both academics and practitioners, as well as areas for further research.

## **2. Theoretical background**

### *2.1 A capability-based perspective*

The principal idea of the resource-based view (RBV) is that the competitive advantage of a firm lies in its heterogeneous resources (e.g., assets, skills, or knowledge), which are rare, valuable, inimitable, and non-substitutable (Barney, 1991). However, RBV has been criticized for not being able to explain how a firm configures its resources to achieve competitive advantage (Teece *et al.*, 1997; Eisenhardt and Martin, 2000; Barney, 2001). In line with RBV, possessing unique resources relevant for service modularity may be a necessary but insufficient condition for realizing service modularity benefits (Ketchen *et al.*, 2007).

Teece *et al.* (1997) propose the concept of capability that emphasizes appropriating,

adapting, integrating, and reconfiguring internal and external organizational competencies to match the requirements of changing environments. Following this line, capabilities enable a firm to constantly reconfigure its resources to sustain competitive advantage. Thus, capabilities are often firm-specific and are developed through complex configurations among the firm's resources (Teece *et al.*, 1997).

In this regard, capabilities are a source of competitive advantage when they are based on a configuration of useful skills, knowledge, and resources. It is this configuration that is so difficult to imitate (Eisenhardt and Martin, 2000). Helfat and Winter (2011) echo that only capabilities meeting the RBV's criteria (rare, valuable, inimitable, and non-substitutable) create competitive advantage. Teece (2007) also indicates that capabilities provide the organization with a new set of decision options, with the potential to increase firm performance. Moreover, Sirmon *et al.* (2011) further indicate that developing capabilities to leverage their resources only helps firms realize their competitive advantage. Overall, the core concept of a capability perspective is the link: strategic capability – strategic resource – competitive advantage – performance. Building on this theoretical foundation, we discuss how service modularity actually influences firm performance in the following sections.

## *2.2 General modular systems theory*

Since many of the studies on modularity have focused mainly on products and ignored services, there were very few studies of service modularity before 2008 (Dörbecker and Böhmman, 2013). In particular, much of the research on product modularity has been used as the basis for service modularity (Cabigiosu *et al.*, 2015). For example, using literature of product modularity, de Blok *et al.* (2014) build a framework to understand interfaces in service modularity. A study by Bask *et al.* (2010) uses the insights stemming from product modularity to discuss service modularity at different levels, such as, the service product level and service process level. However, because of heterogeneity of services and the strong roles of personnel

in the service delivery process (Osei-Frimpong *et al.*, 2015), product modularity research cannot simply be applied to service modularity.

General modular systems theory provides an important theoretical foundation for the development of service modularity in this emerging area. General modular systems theory considers the degree to which the components of a system can be separated and recombined to create a variety of configurations without losing functionality (Schilling, 2000). The implication of general modular systems theory is that modularity as one constructed of standardized units that can be employed in a variety of ways (configuration). In addition, prior to integration, modularity entails subsystems (identification) that can be assembled. Furthermore, modularity should be integrated into different systems (interface) for the same functional purpose with minor modifications. Therefore, firms that are in need of access to service modularity should work to *identify* and *configure* service modules with consideration of *interface* factors. Here, a service module is understood as one service characteristic that involves several service components. Service components are considered the smallest units into which services are divided. Service modules are connected to each other through interfaces, which are the shared linkages among the components.

### *2.3 Theoretical model*

Taking the above arguments together, to design and offer new services in a modular way, firms need to identify and configure service modules with interface linkages. Essentially, such identification and configuration of service modules need unique skills and knowledge in order to achieve superior performance. In this sense, consistent with the RBV, service modularity can be regarded as firms' strategic resources because its unique skills and knowledge constitute an important source of superior performance (Barney, 1991). Since a capability perspective suggests that strategic capabilities are the main drivers of a firm's strategic resources to obtain superior performance (Eisenhardt and Martin, 2000; Teece, 2007; Helfat and Winter 2011),



service modularity needs capabilities that are able to configure service modularity in order to realize its benefits. In this line, this study proposes that firms must develop *service modularity capabilities*, defined as abilities to design services in a modular way, that enable them to implement service modularity. Accordingly, building on a capability perspective: strategic capability—strategic resource—competitive advantage—performance, this study develops a theoretical model that examines the link: service modularity capabilities—service modularity—new service advantage—firm performance.

New service advantage refers to the degree of *superiority* and *meaningfulness* of the new service, in terms of customer solution, customer experience, and technical performance compared to competitors' services (de Brentani, 1989; Im and Workman, 2004). New service advantage is considered a competitive advantage because it concerns the extent to which a new service offers unique benefits and to which it is superior to competing services (de Brentani, 1989). In addition, new service advantage has been considered the most important determinant of service performance (Atuahene-Gima and Li, 2004).

In the following section, this study discusses how firms develop service modularity capabilities that enable them to implement service modularity.

#### *2.4 Service modularity capabilities*

While the importance of organizational capabilities in configuring firms' resources, such as marketing capabilities (Morgan *et al.*, 2009), service innovation capabilities (Kindström *et al.*, 2013), and radical innovation capabilities (Slater *et al.*, 2014), has received much attention, research on service modularity capabilities has been limited. Considering that more detailed information specifically about service modularity capabilities is not available in the existing literatures, we conduct primary qualitative research to further our understanding in this field (the details of which will be described in the Research design section). Along with the relevant literature (e.g., Pekkarinen and Ulkuniemi, 2008; Voss and Hsuan, 2009; Bask *et al.*, 2010; de

Blok *et al.*, 2010; Bask *et al.*, 2011; Rahikka *et al.*, 2011; Ulkuniemi and Pekkarinen, 2011; Carlborg and Kindström, 2014), the field work data obtained from this study indicate that, first, service modularity capabilities are a crucial factor to configure service modularity, and second, three service modularity capabilities are recognized: (1) identification capability; (2) configuration capability; and (3) interface capability.

Identification capability refers to an ability to define and differentiate a service component that has a clear and unique service characteristic in its service system (e.g., for airline companies, purchasing plane tickets or booking a car rental reservation is a unique service characteristic). Configuration capability refers to an ability to separate and combine service components of service systems without loss of their functionality (e.g., to separate purchasing plane tickets and booking a car rental reservation from their original service system, and combine both into a new service). Interface capability refers to an ability to develop standardized functions that connect different service components into new service modules (e.g., a new online program that interconnects purchasing plane tickets and booking a car rental reservation). Participants in this study indicate that firms with strong service modularity capabilities have abilities to configure existing service components into new service modules through well-specified interfaces.

So far, this study identifies three service modularity capabilities within which firms are able to develop service modularity. However, as noted earlier, firms have the tendency to repeatedly modulate existing service components (Tuunanen and Cassab, 2011), which may enable the firms to establish organizational routines of service modularity and, thus, overlook new knowledge (Zhou and Wu, 2010). This, as a result, leads to an ever decreasing effectiveness of service modularity. Thus, it is necessary to investigate how firms sustain their effectiveness of service modularity.

### *2.5 Radical innovation capability*

Firms often operate their organizational activities to maximize the efficiency of business operations (Zhou and Wu, 2010), but their organizational activities may subsequently result in organizational inertia. According to Hannan and Freeman (1984), organizational inertia refers to the stability of organizational activities that underlies the insufficient adaptation to changing environments. When firms' organizational inertia becomes embedded over time, firms create strong resistance against radical changes (Nelson and Winter, 1982). To overcome organizational inertia, a high level of radical change in firms' organizational activities becomes crucial (Zhou and Wu, 2010).

Theoretically, as firms repeatedly operate service modularity, their service modularity may also experience organizational inertia. In particular, firms performing modularity tend to repeatedly modulate existing services in order to quickly develop new services (Tuunanen and Cassab, 2011). Such new services are very likely to be incremental rather than radical (Chandy and Tellis, 2000). To overcome the possibility of service modularity becoming organizational inertia against developing radical new services, a capability that can enhance the development of radical new services appears to be important. Radical innovation capability, as one such capability, is able to help a firm better break down existing organizational routines and develop a tendency toward radical innovations (Menguc *et al.* 2014). As such, radical innovation capability may have the potential to sustain the effectiveness of service modularity.

Radical innovation capability is defined as a firm's ability to reconfigure its organizational resources, knowledge, and activities to create a solution that is radically different from existing ones (Chandy and Tellis, 2000). Firms with radical innovation capability can facilitate their use of new technological trajectories for adaptation and change (Slater *et al.*, 2014). In addition, radical innovation capability can disrupt firms' existing routines and configure interdependent elements of innovation systems to develop radical innovations (O'Connor, 2008; Slater *et al.*, 2014). Thus, radical innovation capability is able to improve and renew existing organizational activities. In this respect, radical innovation

capability should be able to serve as a leverage point to reduce the negative effect (i.e., overuse) of service modularity.

We summarize these various relationships in our conceptual model (see Figure 1) that links service modularity capabilities, service modularity, new service advantage, and firm performance. The model also demonstrates the moderating effect of radical innovation capability on the relationship between service modularity and new service advantage.

**Insert Figure 1 here**

### **3. Hypotheses development**

#### *3.1 Mediating role of service modularity*

Firms with an identification capability are better able to define and differentiate service components of service modularity, which is likely to provide unique service characteristics in their new services (Voss and Hsuan, 2009), and, as a result, increase firm performance. With a configuration capability, firms are better able to separate and/or combine components of service modularity. As such, the functionality of new services is easy to increase, which eventually strengthens firm performance (Kindström *et al.*, 2013). Finally, having an interface capability, firms can more easily develop standardized service functions that connect different service components of service modularity. As a result, new service modules are more likely to be produced, leading to better firm performance (Homburg and Kuehnl, 2014).

Given three service modularity capabilities: identification capability, configuration capability, and interface capability, it is expected that firms are able to develop service modularity, leading to superior firm performance. As such, it is not service modularity capabilities, per se, that directly affect firm performance, but rather using service modularity capabilities in configuring service modularity to increase firm performance. Therefore,

*H1*: Service modularity mediates the effect of service modularity capabilities on firm performance.

### *3.2 Mediating role of new service advantage*

Service modularity and new service advantage may be connected for the following three reasons. First, service modularity is characterized by identifying whether existing service components have the potential to be new service modules (de Blok *et al.*, 2010; Rahikka *et al.*, 2011). Firms with service modularity, in which the identification of service components enables them to produce superior new services, are likely to be able to create new service advantage. Second, service modularity is also characterized by the effective and efficient configuration, alignment, and development of service components into new and unique service offerings to meet customers' needs (Bask *et al.*, 2011; Ulkuniemi and Pekkarinen, 2011). Firms with service modularity, in which the configuration of service components increases meaningfulness of new services to customers, are likely to increase new service advantage (Carlborg and Kindström, 2014). Finally, service modularity can also effectively build standardized functions (e.g., platforms, techniques, or programs) that enable firms to connect well and combine service components (Ulkuniemi and Pekkarinen, 2011). Firms with service modularity, in which the interfaces effectively connect different service components, can quickly launch new services on the market, and, consequently, create new service advantage.

Meanwhile, the service literature generally suggests a link between new service advantage and firm performance, although no empirical study has been conducted to prove the link. For example, Melton and Hartline (2010) indicate that the performance outcomes of a new service increase when the new service is continuously *superior* to competing offerings. Salunke *et al.* (2013) illustrate that the effectiveness of a new service could be strengthened over time, as long as the new service is consistently *meaningful* to customers. Based on these lines of thought,

new service advantage is expected to have a positive effect on firm performance. Therefore,

*H2: New service advantage mediates the effect of service modularity on firm performance.*

### *3.3 The relationship between service modularity and new service advantage*

When a firm uses service modularity, the firm invests substantial resources in it. The accumulation of service modularity knowledge strengthens the firm's ability to evaluate and employ techniques and skills in service modules (Mills and Smith, 2011). According to Volberda *et al.* (2010), absorptive capacity is related to how well a firm can integrate its prior knowledge and new knowledge to achieve desired performance. Therefore, the firm is able to rapidly identify emerging trends in service modularity and become involved in new service modularity knowledge. Accordingly, the accumulation of service modularity leads to superior new service advantage.

However, when firms continue to explore the potential of service modularity for reaping the benefits it can bring, they are likely to rely only on their existing knowledge to identify and implement a new and incremental approach that can make the effective use of service modularity. This is because when organizational activities are embedded in organizational routines over time, the organizational routines produce instinctive responses based on past knowledge and, eventually, develop strong internal resistance to radical change (Nelson and Winter, 1982). Levinthal and March (1993) suggest that firms with superior knowledge in a particular field are more likely to use their existing knowledge to achieve immediate advantage. While firm advantage can increase immediately in the early stage, the self-reinforcing nature of learning makes firms less efficient in exploratory learning and in integrating new knowledge into their existing organizational activities (Christensen, 1997). In this line, although firms can reap the benefit brought by service modularity immediately, in the long run the level of the effectiveness of service modularity decreases, leading to reduced new service advantage.

Therefore,

*H3*: There is an inverted U-shaped relationship between service modularity and new service advantage.

### *3.4 Moderating effect of radical innovation capability*

To overcome organizational inertia of service modularity, firms are required to break down their institutional routines (Zhou and Wu, 2010). According to O'Connor (2008) and Menguc *et al.* (2014), because radical innovation capability emphasizes the reconfiguration of innovation processes and integration of interdependent elements of innovation systems for creating radical innovations, it enables firms to overcome the institutional routines of service modularity. In addition, firms actively using radical innovation capability to supplement their own innovation projects can better reconfigure their innovation practice, and, thus, sustain their performance (Tellis *et al.*, 2009; Slater *et al.*, 2014). Following these lines, with the implementation of radical innovation capability, firms performing service modularity are likely to break down the routines of service modularity and are then able to continuously develop new and radical approaches to implement the concept of service modularity. Since radical innovation capability consists of complementary organizational activities that can enhance service modularity, it could strengthen the effect of service modularity on new service advantage. As such, firms with radical innovation capability are better able to sustain the effect of service modularity on new service advantage. Therefore,

*H4*: Radical innovation capability strengthens the effects of service modularity on new service advantage.

## **4. Research design**

In this section, this study first describes the qualitative method that explores and identifies components and measures of service modularity capabilities. Next, this study presents the details of the questionnaire development, including other measures and two pilot studies. Finally, this study demonstrates the procedures of the quantitative method and the results of nonresponse and common method biases.

#### *4.1 The qualitative method: Exploring components of service modularity capabilities*

To explore possible components of service modularity capabilities, this study employs a qualitative approach. Following the framework proposed by Churchill (1979) and Gerbing and Anderson (1988), this study conducted a convenience sample of 37 in-depth interviews with senior managers who had experience in developing new services through service modularity approaches. The 37 senior managers were from various service industries, including financial services (n=15), information technology services (n=12), tourism services (n=6), and retailing services (n=4). Each interviewee was asked the following four questions:

1. What does “service modularity” mean to you?
2. What are the characteristics of service modularity?
3. What activities are involved when you operate within service modularity?
4. How are your new services produced by way of service modularity? Could you give examples?

On average, each interview took 78 minutes (range = 69 – 94 minutes). To capture all of the important points covered in the interviews, detailed notes were taken and the proceedings of the interviews were tape recorded. With particular interviewees, follow-up interviews were conducted, if necessary, to clarify issues or explore them more deeply. After carefully examining the transcripts, we and two other academics manually and electronically (NVivo 9) converted interviewees’ open-ended responses into categories. Based on the insights from the fieldwork, this study identified three major service modularity capabilities: (1) identification



capability; (2) configuration capability; and (3) interface capability.

## *4.2 The questionnaire development*

### *4.2.1 Developing measures of service modularity capabilities*

With identification of the three service modularity capabilities' components, this study further develops their measures. After an exploratory study, utilizing the same procedures as mentioned above, this study generated an initial pool of items. To ensure that we generated a comprehensive list of service modularity capability items, this study reviewed additional measures related to service modularity and organizational capabilities. As a result, the potential items were also grouped into three categories of service modularity capabilities.

To assess face and content validity, this study performed a pilot test (Churchill, 1979). Another convenience sample of 12 senior managers was carefully selected from four service industries (5 from financial services, 3 from information technology services, 2 from tourism services, and 2 from retailing services), based on their working experience in new service development and service modularity areas. The managers were presented with the list of items and asked to assess the extent to which each sentence represented the right meaning. This process resulted in the slight modification and refinement of some of the items. As a result, the final service modularity capabilities scale contains 10 items representing the three dimensions (identification: 3 items, configuration: 4, and interface: 3).

### *4.2.2 Other measures*

This study measured service modularity through a four-item scale adapted from Duray *et al.* (2000) and Worren *et al.* (2002). Radical innovation capability was measured via three items and adapted from the work of Calantone *et al.* (2002) and Hurley and Hult (1998). New service advantage was measured with five items partially based on the work of de Brentani (1989) and Atuahene-Gima and Li (2004). The scale asked respondents to indicate the extent to which the

new service provided higher quality than competing services, offered unique benefits, and solved customers' problems more effectively than competitive offerings.

Firm performance was measured with the percentage change in return on investment (ROI), return on sales (ROS), and market share from  $t_0$  to  $t_1$ . We obtained financial data on ROI, ROA, and market share from the respondents for the year after the collection of the survey data. For example, we measured ROI as  $(ROI_{t1} - ROI_{t0})/ROI_{t0} \times 100$ . These three dimensions of firm performance capture a variety of financial and market outcomes, and have been established in the literature (Boyer *et al.*, 1997).

Finally, two control variables, firm size and firm age, were included in this study. Larger firms tend to have more resources available, such as financial, personnel, and social capital, and, thus, the ability to undertake a greater number of innovation projects (Shefer and Frenkel, 2005). Therefore, firm size was used as a control and measured on a logarithmic scale using the number of employees. Firm age was also included as a control variable for its potential influence on a firm's growth rate (Chandler and Hanks, 1998), which was measured on a logarithmic scale using the number of years the business had been established. We measured all the items using a 7-point Likert scale for all the constructs in our study (see Appendix).

#### 4.3 Two pilot studies

Two pilot studies were conducted to improve the questionnaire. Before doing the first pilot study, for items adapted from previous literature and written in English, this study used a double-translation method to translate them into Chinese (English-Chinese-English). This process included: (1) the authors initially translating the items into Chinese; (2) another two academics then translating the Chinese version back into English; and (3) this translation being checked by a third academic to ensure conceptual equivalence (Hoskisson *et al.*, 2000). A comparison between the original items and the items translated by the academics demonstrated the desired consistency. Based on their feedback, a draft questionnaire was prepared that

included measurement items judged to have high content and face validity.

The first pilot study included semi-structured interviews with another convenience sample of 34 senior service managers from financial services (n=9), information technology services (n=9), tourism services (n=8), and retailing services (n=8), with experience using service modularity to develop new services. On average, face-to-face interviews of 38 minutes were conducted with each interviewee. All interviewees were asked to comment on items that were not currently in the instrument but ought to have been included; items that ought to have been excluded; the comprehensibility of the questions; the length and complexity of the questionnaire; and the relevance and usefulness of the research. Based on these comments, the revised instrument was used for the second pilot study.

The second pilot study was performed to ensure the measurement was reliable (Churchill, 1979). Based on another convenience sample of 47 senior managers from information technology services (n=15), financial services (n=13), tourism services (n=10), and retailing services (n=9), who had at least 10 years' working experience in service innovation, the results exhibit a high degree of reliability (Cronbach's alpha values were greater than .86), with all measures exceeding the recommended levels.

#### *4.4 The quantitative method: Sampling and data collection*

A survey approach, one of the quantitative methods, is used because existing research on service modularity often provides anecdotal evidence (Dörbecker and Böhmman, 2013) and because it allows us to empirically test the relationships among service modularity capabilities, service modularity, radical innovation capability, new service advantage, and firm performance (Hair *et al.*, 2010).

Based on a commercial list published by the China Credit Information Service Company (2011), this study developed a contact list of senior managers from 856 firms in service industries. As in similar studies on strategy and service innovation (e.g., Morgan *et al.*, 2009),

senior managers were selected as key informants because they are typically the ones who take responsibility for the development of new services and are highly familiar with the use of firm capabilities.

Before scheduling on-site interviews, the researchers contacted the senior managers via phone to state the purpose of the project and determine their willingness to participate. Of the 856 firms contacted, 213 usable responses were obtained, with a response rate of 24.8%. The sample consists of information services (20.8%), financial services (19.6%), tourism and travel services (18.3%), technical and scientific services (21.2%), retailing services (18.7%), and others (1.4%). A significant majority of the businesses (65.2%) have been in existence for at least 10 years. The firms' annual sales figures ranged from 3.4 million to 35.6 million U.S. dollars, and the number of employees varied from 492 to 9,045, with 58.2% of firms reporting more than 1,000 employees. The respondents, who were senior managers, had been with their firms on average for 14 years of experience in NSD, which suggests a high level of knowledge competency.

#### *4.5 Nonresponse bias and common method bias*

To check for nonresponse bias, we compared a sample of participating and non-participating firms. The analysis of variance test shows no significant difference between the two groups in terms of firm size ( $F = 0.96$ ) or firm age ( $F = 1.13$ ).

We first conducted a Harman one-factor test that assessed the potential problem of common method bias (Podsakoff and Organ, 1986). A factor analysis of all these constructs resulted in a solution with expected factors, which accounted for 75.49% of the total variance, and the first factor accounted for 23.24% of the variance.

We also employed the confirmatory factor analyses (CFA) approach, in which all the items were modeled as the indicators for a single factor representing method effects. The results suggest unsatisfactory model fit ( $\chi^2 / \text{d.f.} = 8.12$ , root mean squared error of

approximation (RMSEA) = .16, confirmatory fit index (CFI) = .55, incremental fit index (IFI) = 0.46, and non-normed fit index (NNFI) = 0.58). Therefore, common method bias is not a concern in this study.

## **5. Analysis and results**

### *5.1 Validation of measures*

The factor structure and measurement quality of the measures were examined by principal component analysis and evaluation of the eigenvalues (Hair *et al.*, 2010). The results indicate that the items are loaded as expected, and the Cronbach's alpha values for all measures are well above the threshold recommended value of 0.7 (Nunnally, 1978). Next, by using CFA, the measurement models show that the factor loadings for each individual indicator, on its respective constructs, are statistically significant ( $p < .001$ ), and there is no evidence of cross-loading, supporting the dimensionality and convergent validity of the constructs. The composite reliabilities of each construct range also exceed the usual .70 benchmark (Hair *et al.*, 2010). Finally, discriminant validity was assessed by using the Fornell and Larcker (1981) procedure and an alternative procedure that Anderson and Gerbing (1988) recommend. As shown in Table III, for each construct the value of the square root of each average variance extracted is greater than the values of the inter-construct correlations. In addition, the unconstrained models outperform the constrained models in all cases. Both results demonstrate discriminant validity.

**Insert Table III Here**

### *5.2 Hypotheses testing: the mediating effects*

Following Baron and Kenny (1986), this study tested the mediating effects through structural equation modeling (SEM), using LISREL version 8.8 (Joreskog and Sorbom, 2006). SEM was

used because it is a preferred method for testing theoretical relationships and it also addresses unreliability directly by using multiple indicators of each construct in a causal model (Byrne, 2013). The results of structural models are presented in Tables II, III, and IV.

We first tested two structural models of the relationships among service modularity capabilities, service modularity, and firm performance (see Table IV). Model 1 suggests that both an aggregated level of and three individual levels of service modularity capabilities have significant effects on three indicators of firm performance.

The results in Model 2 show that when service modularity is included in the model, both an aggregated level of and three individual levels of service modularity capabilities are significantly related to service modularity. However, the effects of both an aggregated level of and three individual levels of service modularity capabilities lose their significance on firm performance. The results suggest that the links between service modularity capabilities and firm performance are indirect through service modularity. Therefore, the results indicate that service modularity fully mediates the relationship between service modularity capabilities and firm performance, supporting Hypothesis 1.

#### **Insert Table IV Here**

We then tested the mediating effect of new service advantage between service modularity and firm performance (see Table V). Model 3 suggests that service modularity has a significant effect on three indicators of firm performance. When new service advantage is included in the model, Model 4 shows that new service advantage has significant positive effects on ROI, ROS, and market share of firm performance. However, the effects of service modularity on firm performance are insignificant. Table VI (Model 5: service modularity capabilities—service modularity—new service advantage—firm performance), shows that the full structural model has consistent results. Therefore, the findings suggest that new service advantage fully

mediates the relationship between service modularity and firm performance, supporting Hypothesis 2.

### **Insert Tables V and VI Here**

#### *5.3 Hypotheses testing: the moderating effect*

The moderating effect was tested by using hierarchical moderated regression analyses (Aiken and West, 1991). Hierarchical moderated regression analyses offer some complementary benefits to SEM, such as the ability to calibrate the relative impact of the interaction between service modularity capabilities and radical innovation capability (Hair *et al.*, 2010). As shown in Table VII, three hierarchical regressions were estimated: (1) one including the control variables only; (2) one adding service modularity, radical innovation capability, and service modularity squared; and (3) one adding the service modularity  $\times$  radical innovation capability interaction and the service modularity squared  $\times$  radical innovation capability interaction. Prior to this process, all variables involved were standardized to minimize potential multicollinearity (Tabachnick and Fidell, 2007). We also checked for multicollinearity by examining variance inflation factors for all the variables. The results show that the largest variance inflation factor in any of the hierarchical regressions is 2.12 (below the cutoff of 10), indicating that no multicollinearity concerns exist (Mason and Perreault, 1991; Hair *et al.*, 2010).

### **Insert Table VII Here**

As shown in Table VII (Model 2), service modularity is positively related to new service advantage ( $\beta = .31, p < .01$ ), and the coefficient for service modularity squared is negative and significant ( $\beta = -.18, p < .05$ ). The results imply that the link between service modularity and new service advantage is an inverted U-shaped relationship (Aiken and West, 1991). This

curvilinear relationship was further explored through a partial derivative of the regression function. The results ( $Y = -.18X^2 + .31X$ , where  $Y$  is new service advantage and  $X$  is service modularity) indicate that the regression function reaches its maximum when service modularity = 0.86. This suggests that for values less than 0.86, there is a positive relationship between service modularity and new service advantage. However, beyond that, the relationship turns negative. Thus, there is evidence of an inverted U-shaped relationship between service modularity and new service advantage. Hypothesis 3 is supported, suggesting that organizational activities, such as service modularity, will result in organizational inertia over time, which will produce negative performance (Hannan and Freeman, 1984).

We then assessed the model with the interaction variable of radical innovation capability. As Model 3 in Table VII shows, the interaction between radical innovation capability and service modularity positively affects new service advantage ( $\beta = .26, p < .01$ ), and service modularity squared interacts is also positively related to new service advantage ( $\beta = .19, p < .05$ ). The results suggest that radical innovation capability strengthens the positive effects of and alleviates the negative effects of service modularity on new service advantage. Hypothesis 4 is supported. Finally, the regression results indicate that the relationships are not significantly affected by firm size or firm age.

#### *5.4 Additional robust analysis*

To better understand the interaction effects, we performed simple slope tests and plotted the relationships following Aiken and West (1991). We first split radical innovation capability into high and low levels (standard deviation above/below the mean). Then, we estimated the effect of service modularity on new service advantage for both levels. The results show that the positive effect of service modularity on new service advantage is stronger when radical innovation capability is high ( $\beta = .37, p < .01$ ) than when it is low ( $\beta = .21, p < .05$ ). Similarly, the effect of service modularity squared on new service advantage is positively stronger when



radical innovation capability is high ( $\beta = .28, p < .01$ ) than when it is low ( $\beta = .19, p < .05$ ). Overall, the Hypothesis 4 results confirm that radical innovation capability helps firms sustain the effectiveness of service modularity. This finding supports a capability perspective, indicating that radical innovation capability can work together with organizational activities to sustain their impact on performance outcomes (O'Connor, 2008; Tellis *et al.*, 2009; Slater *et al.*, 2014).

## 6. Discussion

A critical challenge for firms that adopt service modular strategies is: how does service modularity actually and continuously contribute to firm performance? This study addresses this issue by empirically examining the mediating role of new service advantage to link between service modularity and firm performance, the antecedent role of service modularity capabilities to configure service modularity, and the moderating role of radical innovation capability to sustain the effectiveness of service modularity.

The empirical findings reveal that new service advantage mediates the service modularity – firm performance relationship. Moreover, service modularity capabilities act in an important antecedent role to configure service modularity. Among the findings, it is worth emphasizing that radical innovation capability not only strengthens the positive effect of, but also alleviates the negative effect of, service modularity on new service advantage. Our findings provide important theoretical and managerial implications.

### 6.1 Theoretical implications

First, this study's findings support the RBV indicating that firms' resources, such as service modularity, can be valuable in enabling firms to achieve desired performance in terms of new service advantage and firm performance (Barney, 1991). In addition, the results suggest that service modularity capabilities are the foundation for configuring service modularity. This

finding is consistent with a capability perspective in which firms' capabilities, such as service modularity capabilities, play an important role in configuring organizational resources (Eisenhardt and Martin, 2000; Teece, 2007; Helfat and Winter 2011). Furthermore, this study empirically identifies three service modularity capabilities: identification, configuration, and interface. This finding supports a capability perspective indicating that capabilities are a complex configuration of sub-capabilities which allow hierarchical structures to be specified (Newbert, 2007). As such, the important role played by service modularity capabilities in determining service modularity is identified and supported empirically, which, in turn, may explain significant variance in the effectiveness of service modularity for researchers. The identification of service modularity capabilities as an important driver of service modularity is akin to some other types of capabilities serving as a key driving force of respective organizational resources or activities, such as radical innovation capabilities for enhancing the effect of radical innovation on firm performance (Slater *et al.*, 2014) or service innovation capabilities for strengthening the effect of service resources on service innovation development (Kindström *et al.*, 2013). What is different is that, prior to this study, current literature has not yet identified the potential role of service modularity capabilities in service modularity.

Second, this study's results reveal that service modularity is important in determining firm performance only through its effect on new service advantage. This finding supports a capability perspective suggesting that firms' capabilities can help realize the firms' competitive advantage, such as new service advantage, through leveraging their resources (Ketchen *et al.*, 2007; Sirmon *et al.*, 2011). Previous studies of service modularity seem to focus mostly on how characteristics of service modularity, such as design processes of service modularity (e.g., Rahikka *et al.*, 2011) or components of service modularity (e.g., Tuunanen and Cassab, 2011), are related to firm performance and pay scant attention to how service modularity actually influences firm performance. This insight adds to the service modularity literature by suggesting that if research neglects the role of new service advantage in examining the service

modularity—firm performance relationship, it may yield an inaccurate estimation of the service modularity effects.

Third, this study's findings provide a better understanding of why the inconclusive performance results of service modularity may happen. Specifically, most researchers agree that service modularity could help firms improve new service performance (e.g., Carlborg and Kindström, 2014; Ulkuniemi and Pekkarinen, 2011; Voss and Hsuan, 2009). On the contrary, Tuunanen and Cassab (2011) argue that because common service components are repeatedly used, firms may develop new services with a similar design and, thus, decrease their new service performance. Our findings indicate that service modularity is not always positively related to new service advantage. Instead, service modularity has an inverted U-shaped relationship with new service advantage. In the early stage, service modularity relates to the highest degree of new service advantage, while in later stages, service modularity loses its impact on new service advantage. This may explain the conflicting performances of service modularity in the previous literature.

Finally, our findings support organizational inertia literature (Hannan and Freeman, 1984) indicating that, if a firm accumulates service modularity know-how, it likely becomes more efficient in evaluating, configuring, and using existing knowledge to service extensions and refinements. Over time, organizational inertia can be expected to be rooted in the firm's routines and processes of service modularity, which causes the firm to overlook emerging new knowledge and, as a result, fail to sustain the effectiveness of service modularity. To overcome the organizational inertia of service modularity, this study proposes and confirms empirically that radical innovation capability strengthens the positive impact of service modularity. Most importantly, radical innovation capability overcomes the negative impact of service modularity on new service advantage. This finding also supports the perspective of resource—capability complementarity (Song *et al.*, 2005), suggesting that radical innovation capability enables firms to achieve more from the use of the service modularity concept.

## *6.2 Managerial implications*

First, although service modularity has been recently discussed as one of the useful approaches to generating new services, this study cautions managers that it is not service modularity that directly influences firm performance. Our findings underscore the importance of paying more managerial attention to the underlying process through which service modularity influences firm performance. Service modularity capabilities act as an impetus that affects firms' service modularity development and new service advantage, which consequently have effects on firm performance. However, service modularity capabilities alone may not help firms attain desirable performance, without their efforts in developing and implementing service modularity and transforming that into new service advantage. Therefore, managers should not only focus their efforts on adopting service modularity strategies, but also devote attention to the underlying managerial process in order to realize the potential value of service modularity. All in all, managers need to understand the comprehensive relationship of service modularity capabilities–service modularity–new service advantage–firm performance so that they can monitor the processes and focus their efforts on developing service modularity capabilities and new service advantage.

Second, firms must be aware of the limitations of their existing service modularity that can adversely affect their development of radical innovation. Firms that continuously rely on the use of the existing service modularity should be aware that, although this helps to create new service advantage, over time they may suffer from the effect of organizational inertia. As a result, firms focus on existing service modularized processes on developing incremental new service and overlook exploring radical new services. Managers should anticipate this result and make a careful trade-off in order to optimize firm performance. With this concept in mind, managers should regularly check new service advantage against service modularity. If there are any signs of reduction in the new service advantage, managers should halt further modularizing

of their existing service. This study suggests that managers can develop and use radical innovation capability to diminish the negative effects of service modularity. By making use of radical innovation capability, managers can strengthen the deployment of resources and help firms escape the organizational inertia trap.

Third, the identification of service modularity capabilities helps managers understand what makes a firm effective in configuring service modularity. This insight is necessary for managers who intend to adopt strategies of service modularity, or who aim for increasing the effectiveness of their current service modularity. In addition, because service modularity capabilities consist of three aspects of capabilities, managers may need to assess the magnitude of each aspect of service modularity capabilities for their configuration of service modularity.

### *6.3 Limitations and further research*

Our study has a number of limitations, which also represent important directions for future research. First, this study focuses on investigating the effects of interaction between service modularity and radical innovation capability. Apart from radical innovation capability, there are many other types of organizational capabilities, such as strategic flexibility and operating adaptability, which may also interact with service modularity. Future research could explore the effects of interaction between service modularity and other types of organizational capabilities. In addition, previous literature (e.g., Slater et al., 2014) suggests that radical innovation capability alone may have an impact on new service advantage and firm performance. Future research could extend our proposed model by exploring the impact of radical innovation capability on new service advantage and firm performance.

Second, our choice of new service advantage as a mediator enables us to advance a robust theoretical model for explaining how service modularity actually contributes to firm performance. Nonetheless, our finding of mediation through new service advantage does not justify neglecting other theoretically important mediators, such as service innovativeness or

service productivity. Therefore, it would be fruitful for future studies to consider other mediators beyond new service advantage.

Third, our study investigates the effects of three service modularity capabilities (identification, configuration, and interface) on service modularity. As these three capabilities may have differing effects on service modularity, future research could explore these potential differences. By knowing these differences, firms can devote disproportionately more resources to the capability that exerts the greatest impact on service modularity.

In addition, while we used two pilot studies and tested nonresponse and common method bias to address possible concern of developing new items (service modularity capabilities), the cross-sectional nature of the research allows analysis of the firms at only one specific point in time, rather than their overall conduct over a period of time (Guide *et al.*, 2015). This issue is even more noteworthy as the development of strategic capabilities usually evolves over a long time (Eisenhardt and Martin, 2000; Teece *et al.*, 1997). Future research could attempt to avoid such concerns by employing a longitudinal analysis.

The final limitation is based on the authors' local understanding of the Taiwanese service industry. Firms in this industry face fierce rivalry for a slice of the small domestic market. Its degree of internationalization, compared to many other countries also having their service industry occupying more than 70% of GDP, is relatively low. All of these environmental constraints contribute to a high level of environmental uncertainty among service firms in Taiwan. This is because they have to face new and increased competition from a new player or new service product from time to time, and their current position or market share could easily be jeopardized in a short time interval. This uneasy feeling of environmental uncertainty makes some Taiwanese service firms take the bold but potentially rewarding measure of pursuing radical innovations. Therefore, environmental uncertainty, which is omitted from the research model in this study, may play a significant role in establishing radical innovation capability and deciding on the path of development of service modularity. Future research could incorporate

environmental uncertainty into the research model developed and validated in this study, and test the subsequently expanded model.

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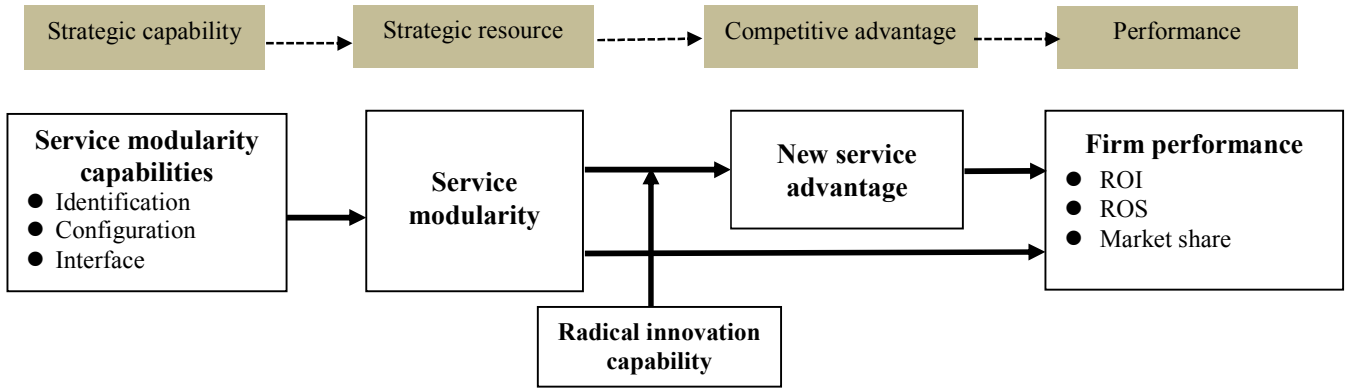
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## APPENDIX

	Factor loading	t-value
<b>Service modularity</b> (reflecting a firm designs and offers new services in a modular way. Items are adapted from Duray <i>et al.</i> , 2000; Worren <i>et al.</i> , 2002; $\alpha = .91$ ; CR = .90)		
How would you describe your main service?		
Service can be decomposed into separate modules.	.81	11.26
We can make changes in the key component without redesigning others.	.85	12.06
Service components can be re-used in various services.	.86	12.44
Service has high degree of component carry-over.	.78	10.68
<b>Service modularity capabilities</b>		
<b>Identification capability</b> (New items that reflect a firm's ability to identify service components so as to modularize new services, $\alpha = .89$ ; CR = .86)		
We identify service components in existing services.	.83	11.62
We differentiate the differences between two service components.	.82	11.45
We define service components in new services.	.81	11.32
<b>Configuration capability</b> (New items that reflect a firm's ability to configure service components so as to modularize new services, $\alpha = .88$ ; CR = .87)		
We detach service components from service systems.	.75	9.97
We link different service systems' service components together into new service systems.	.78	10.73
We group service components that have similar characteristics into new service systems.	.83	11.67
We skillfully use separate and combine service components to develop new services.	.80	11.21
<b>Interface capability</b> (New items reflect a firm's ability to connect service components through developing or using standard platforms, techniques, or programs so as to modularize new services, $\alpha = .86$ ; CR = .88)		
We develop standard platforms, techniques, or programs to connect service components.	.84	11.95
We use standard platforms, techniques, or programs as basic functions to develop new services.	.81	11.36
We form standard platforms, techniques, or programs between two service components.	.88	12.68
<b>Radical innovation capability</b> (reflecting a firm's ability to develop radical service innovations. Items are adapted from Calantone <i>et al.</i> , 2002; Hurley and Hult, 1998; $\alpha = .92$ ; CR = .91)		
We have activities for exploiting the most up to date technologies/techniques available.	.94	14.04
We have activities for developing radical new services.	.86	11.46
We have activities for fundamentally changing existing services.	.83	10.93
<b>New service advantage</b> (reflecting a user's perspective with regard to the differential superiority of a new service compared with competing services. Items are adapted from de Brentani, 1989; Atuahene-Gima and Li, 2004; $\alpha = .92$ ; CR = .93)		
The quality of the new service compares well with similar competitor services.	.74	9.95
The new service is of higher quality than competing services available to customers.	.89	12.90
The new service solves problems customers had with competitor services.	.94	14.04
The new service offers unique benefits to customers.	.86	11.46
The new service performance meets established standards better than competition.	.83	10.93

**Figure**



**Figure 1. The conceptual model**

## Tables

**Table I. Concepts, definitions, and examples regarding service modularity**

Concept	Definition	Examples				
		Information services	Financial services	Tourism and travel services	Technical and scientific services	Retailing services
Service modularity	The design of a new service that combines different service components through interfaces	Wireless satellite and broadcasting news letter	Financial services vertical within management consultancies	Online services for booking both plane tickets and car rental	Laboratory testing services	Mobile phone Apps
Service components	An element constituting a service	<ul style="list-style-type: none"> <li>● Extreme weather warnings</li> <li>● Personal safety notifications</li> </ul>	<ul style="list-style-type: none"> <li>● Management consultants, such as business analysis, change management</li> <li>● Financial service sectors, such as Equities, Fixed Income</li> </ul>	<ul style="list-style-type: none"> <li>● Purchasing plane tickets</li> <li>● Booking car rental reservations</li> </ul>	<ul style="list-style-type: none"> <li>● Technology consulting</li> <li>● Radiation testing center</li> </ul>	<ul style="list-style-type: none"> <li>● Retailing stores</li> <li>● Internet shopping</li> </ul>
Interface	A point where two service components connect	Communication platforms	Two or more specialises	Online platforms	Testing platforms in laboratories	Mobile phone operating systems

**Table II. A summary of main existing studies on service modularity**

Authors	Types of study/data	Purpose of study	Research findings
Pekkarinen and Ulkuniemi, 2008	Qualitative/ a single case study	To explore the literature related to modularity in developing and manufacturing physical products in order to employ the idea of modularity into the business services context	The developed modular service platform including four modularity dimensions: service, process, organisational and customer interface dimensions can be used to create value in business services
Gentry and Elms, 2009	Quantitative/observations on 260 firms over five years	To empirically examine the performance outcomes associated with a range of modularity levels	The more firms rely on partially modular arrangements, the lower their performance
Voss and Hsuan, 2009	Quantitative/a mathematical model	To understand the nature of service architecture and modularity	To possession of unique service modules or elements not easily copied in the short term by competitors; the ability to exploit these through replication across multiple services and/or multiple sites; and the presence of a degree of modularity, which in turn supports both customization and rapid new product development
Bask <i>et al.</i> , 2010	Qualitative/a literature review	To describe the current state of modularity research and to clarify the concept and impacts of modularity	Four key themes and definitions associated with modularity in different perspectives
de Blok <i>et al.</i> , 2010	Qualitative/case study of the provision of care and services to independently living elderly	To show how modularity manifests in a service context	Modularity theory should distinguish between the creation of modular offerings in care provision versus their creation in goods production, since the findings are the exact reverse of the state-of-the art knowledge in manufacturing modularity
Bask <i>et al.</i> , 2011	Qualitative/case study of the logistics service industry	To connect modularity to business models and processes in order to facilitate understanding of how modular structures can be applied in services	By providing flexibility and customisation, modularity can provide a background for the development of business models and processes and can assist in the development of more efficient service processes
Rahikka <i>et al.</i> , 2011	Qualitative/case study of a large provider of professional services	To find out how services provided in service modularity can exert an influence on the value perception of the customer	The modular processes had an influence on the customer's expectations that are related to the experienced quality of the service, and hence they create value for the customer

Tuunanen and Cassab, 2011	Qualitative/two experimental studies	To integrate software engineering insights with research on service process design and product extensions to propose the concept of service process modularization and examine its influence on customer trial of service innovations	Modularization increases both the perceived utility of an enhanced offering and the likelihood of trial for service extensions. The effect of modular reuse versus variation, however, is contingent on the task complexity of the base service
Ulkuniemi and Pekkarinen, 2011	Qualitative/case study of a modular service in a professional service firm	To explore how modularity makes services visible and how it enables the customers to participate in service co-creation	A modular service offering can help customers by increasing the visibility of the service offering
de Blok <i>et al.</i> , 2014	Qualitative/case study of elderly care	To explore characteristics of interfaces and the role they play in service customization	Four interface categories are distinguished, which offer a specification of the interfaces' function in creating variety and coherence, when linking content components as well as service providers
Carlborg and Kindström, 2014	Qualitative/case study of three Swedish manufacturing firms	To investigate the role of service modularity in developing and deploying efficient services, while at the same time meeting diverse customer needs	The emerging field of service modularity by investigating process modularization and modular strategies
Cabigiosu <i>et al.</i> , 2015	Qualitative/two in-depth case studies of third-party logistics	To investigate service modularity and inter-organizational coupling in knowledge-intensive business services	Service modularity and inter-organizational decoupling are aligned for knowledge sharing but not for information sharing, which remains high regardless of the service architecture

**Table III. Descriptive statistics, correlations, and AVEs**

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11
1 Service modularity	5.17	1.14	<b>.68</b>										
2 Identification capability	4.98	1.08	.36**	<b>.67</b>									
3 Configuration capability	4.45	.96	.39**	.12	<b>.63</b>								
4 Interface capability	4.12	.79	.35**	.11	.10	<b>.71</b>							
5 New service advantage	5.24	1.42	.23*	.19*	.18*	.21*	<b>.73</b>						
6 Radical innovation capability	5.04	1.03	.10	.09	.06	.08	.14	<b>.77</b>					
7 ROI	3.75	17.81	.29*	.21*	.24*	.22*	.32**	.25*	-				
8 ROS	3.12	19.08	.39**	.28*	.29*	.24*	.35**	.26*	.28*	-			
9 Market share	2.69	16.87	.28*	.15*	.25*	.20*	.22*	.23*	.22*	.26*	-		
10 Firm size (log)	4.33	1.23	.06	.09	.11	.08	.10	.16*	.05	.04	.12	-	
11 Firm age (log)	5.01	1.52	.09	.10	.08	.04	.12	.09	.06	.13	.11	.10	-

Notes: S.D.: standard deviation; ROI: return on investment; ROS: return on sales

Bold figures on the diagonal are the square root of the AVE

\*\*  $p < 0.01$ ; \*  $p < 0.05$  (N = 213)**Table IV. Results of structural model 1 and 2**

	Model 1				Model 2		
	Service modularity capabilities–Firm performance			Service modularity capabilities–Service modularity–Firm performance			
	ROI	ROS	Market share	Service modularity	ROI	ROS	Market share
Service modularity capabilities	.39*** (3.39)	.37*** (5.14)	.52*** (4.22)	.38*** (5.02)	.09 (.84)	.02 (.26)	.07 (.61)
Identification capability	.46*** (5.32)	.41*** (3.92)	.54*** (5.61)	.28** (3.39)	.11 (1.04)	.05 (.66)	.12 (1.16)
Configuration capability	.39*** (5.13)	.19* (2.34)	.41*** (5.24)	.24** (3.16)	.10 (.98)	.03 (.34)	.13 (1.21)
Interface capability	.36*** (5.11)	.18* (2.09)	.27** (3.21)	.21* (2.52)	.04 (.39)	.07 (.66)	.09 (.81)

Model fit (model 1):  $\chi^2$  / d.f. = 2.19, RMSEA=0.08, CFI = 0.90, IFI = 0.91, NNFI = 0.90Model fit (model 2):  $\chi^2$  / d.f. = 1.94, RMSEA=0.04, CFI = 0.96, IFI = 0.97, NNFI = 0.95Standardized coefficients are presented with  $t$ -value in parentheses\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$  (N=213)**Table V. Results of structural model 3 and 4**

	Model 3			Model 4			
	Service modularity–Firm performance			Service modularity–New service advantage–Firm performance			
	ROI	ROS	Market share	New service advantage	ROI	ROS	Market share
Service modularity	.34*** (4.72)	.31*** (4.59)	.28** (4.37)	.38*** (4.89)	.09 (1.17)	.12 (1.47)	.10 (1.13)
New service advantage					.23** (2.78)	.21** (2.65)	.19* (2.56)

Model fit (model 3):  $\chi^2$  / d.f. = 1.87, RMSEA=0.06, CFI = 0.92, IFI = 0.94, NNFI = 0.94Model fit (model 4):  $\chi^2$  / d.f. = 2.52, RMSEA=0.08, CFI = 0.91, IFI = 0.90, NNFI = 0.92Standardized coefficients are presented with  $t$ -value in parentheses\*\*  $p < .01$ ; \*\*\*  $p < .001$  (N=213)



**Table VI. Results of structural model 5**

<b>Model 5</b>					
	Service modularity capabilities-Service modularity-New service advantage-Firm performance				
	Service modularity	New service advantage	ROI	ROS	Market share
Service modularity capabilities	.36*** (4.16)	.32*** (4.13)	.10 (1.32)	.16 (1.72)	.13 (1.52)
Identification capability	.44*** (4.43)	.46*** (4.58)	.03 (.27)	.14 (1.52)	.06 (.57)
Configuration capability	.39*** (4.30)	.38*** (4.22)	.16 (1.73)	.10 (1.02)	.02 (.26)
Interface capability	.29*** (3.97)	.21* (3.67)	.11 (1.23)	.12 (1.41)	.08 (.86)
Service modularity		.26* (3.84)	.09 (.95)	.04 (.42)	.03 (.31)
New service advantage			.25* (3.81)	.31*** (4.02)	.29*** (3.98)

Model fit:  $\chi^2 / \text{d.f.} = 1.72$ , RMSEA=0.04, CFI = 0.98, IFI = 0.96, NNFI = 0.95

Standardized coefficients are presented with *t*-value in parentheses

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$  (N=213)

**Table VII. Results of hierarchical moderated regression**

	New service advantage		
	Model 1	Model 2	Model 3
Firm size	.06 (.72)	.04 (.42)	.01 (.20)
Firm age	.09 (1.16)	.08 (1.07)	.07 (.98)
Service modularity (SM)		.31** (3.28)	.28** (2.87)
Radical innovation capability (RIC)		.24** (2.65)	.25** (2.63)
SM squared		-.18* (2.06)	-.10 (1.23)
SM $\times$ RIC			.26** (2.69)
SM squared $\times$ RIC			.19* (2.11)
Adjusted R <sup>2</sup>	.11**	.19**	.30**
$\Delta R^2$		.08**	.11**
F-value	3.66**	4.37**	5.32**

Standardized coefficients are presented with *t*-value in parentheses

\*  $p < .05$ ; \*\*  $p < .01$  (N=213)