

Exploring service innovation and value creation: The critical role of network relationships

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Abstract

This study examines the role of service innovation, including service process, Information Technology infrastructure and customer acuity, on customer satisfaction from the network relationships perspective. This study tests the hypotheses in a sample of 136 companies, which is drawn from top 5,000 Taiwanese firms listed in the 2015 yearbook published by the China Credit Information Service Incorporation. The results indicate that service innovation is positively related to network relationships, and that network relationships have a positive effect on customer satisfaction. Also, the results provide evidence that network relationships play a mediating role between service innovation and customer satisfaction. The findings of this study contribute to the theoretical development of a conceptual model for explaining the interrelationships among service innovation, network relationships, and customer satisfaction. The empirical evidence of the Sobel test, in line with Baron and Kenny's procedure and bootstrap analysis supports the process-oriented view and indicates that network relationships mediate the effect of service innovation on customer satisfaction. Finally, this study discusses managerial implications and highlights future research directions.

Keywords: service innovation, value creation, network relationships

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INTRODUCTION

The service industry is characterized by a variety of features that distinguish it from the manufacturing industry (de Bandt & Gadrey, 1994; de Bandt, 1995; Gebauer & Fleisch, 2005; Gebauer, Fleisch, & Friedli, 2005; Eloranta & Turunen, 2014). The service sector not only comprises many diverse activities, but also shares characteristics that set it apart from the manufacturing sector. These characteristics determine the nature of innovation in service firms (Pires, Sarkar, & Carvalho, 2008; Sepulveda, 2014). The interaction and inseparability of production and consumption in services means that much innovation is aimed at adapting the product to meet clients' needs (Toivonen & Tuominen, 2009; Gremyr, Witell, Löfberg, Edvardsson, & Fundin, 2014).

The unique characteristics of services imply that the service performance should be based on the interaction and participation of customers in the production of services (Chase, 1978; Normann, 1984; Mills & Morris, 1986; Lovelock & Yip, 1996). Customers in service industries can be viewed as 'partial' employees (Mills, Chase, & Margulies, 1983; Kindström, Kowalkowski, & Alejandro, 2015) and their perceptions of service quality can be considered to be an attitude about a service interaction

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(Doucet, 2004). Customers' evaluation of service quality affect a range of consumption behaviors that are profitable for the service industry (Zeithaml, Berry, & Parasuraman, 1996). In other words, the economic value of service industry will not be created without customers' experiences (Pine & Gilmore, 2000) and its added value is closely connected to improving the lives of customers. To keep the sustained upgrading in a service industry, innovation has been regarded as the core competency (Kandampully, 2002).

Most researchers agree that service innovation is critical for both service and manufacturing firms' short- and long-term success (e.g., De Jong, Bruins, Dolfma, & Meijgaard, 2003; Tidd & Hull, 2003; Bryson & Monnoyer, 2004; Matear, Gray, & Garrett, 2004; Lu, Lin, & Wu, 2005; Miles, 2005; Berry, Shankar, Parish, Cadwallader, & Dotzel, 2006; Kjellberg, Azimont, & Reid, 2015). Consequently, understanding the factors that contribute to successful service innovation is an important area of inquiry among academics and practitioners (Castellacci, 2008; Mansury & Love, 2008; Carlborg, Kindström, & Kowalkowski, 2014). Some studies have noted the effects of service innovation on performance. Service innovation is a source of competitive advantage that increases customer satisfaction (Hull, 2004; Cusumano, Kahl, & Suarez, 2015). Some researchers suggest that the more service innovation activities a company implements, or the stronger a firm's focus on service innovation, the better its performance (Han, Kim, & Srivastava, 1998; Eisingerich, Rubera, & Seifert, 2009). Firms that have a greater capacity to innovate respond better to competitive pressures by developing new capabilities that provide a competitive advantage (Montes, Moreno, & Fernández, 2004). This is especially true for service firms, but when these firms are unable to protect their innovation by patenting, imitation by competitors can quickly erode any advantage gained through an innovation (Sundbo, 1997; Miles, Andersen, Boden, & Howells, 2000). This aspect of service companies helps explain why knowledge, particularly new knowledge, is such a key resource (Kandampully, 2002) for service innovation. Service innovation results from an interactive process in which different specialized agents exchange, absorb and assimilate knowledge in a physical or socially shared context (Autio, Hameri, & Vuola, 2004). This process does not depend solely on the knowledge that service providers develop internally, but also on service providers' capacities to assimilate the knowledge of their customers (Cohen & Levinthal, 1990; Nätti, Hurmelinna-Laukkanen, & Johnston, 2014).

Network relationships may enable firms to accelerate access to knowledge, support innovativeness, and competitive advantage creation (Mills & Morris, 1986). In the realm of service innovation, many studies recognize the importance of closer interaction, which is a key characteristic of service (Sirilli & Evangelista, 1998; Gadrey & Gallouj, 2002; Kang & Kang, 2014). In addition, some past studies have proven that interactions with customers, such as communication or consumer contact and co-production, affect customer satisfaction (Blazevic & Lievens, 2004; Skaggs & Youndt, 2004; Mahr, Lievens, & Blazevic, 2014).

Prior studies have empirically examined the effects of service characteristics (e.g., Evangelista & Sirilli, 1995; Djella & Gallouj, 1999; Gebauer & Fleisch, 2005; Gebauer, Fleisch, & Friedli, 2005; Love & Mansury, 2007; Mansury & Love, 2008), service taxonomy and models (e.g., Den Hertog & Bilderbeek, 1999; Fitzsimmons & Fitzsimmons, 2006; Lay, Copani, Jäger, & Biege, 2010), close interactions (e.g., Sirilli & Evangelista, 1998; Gadrey & Gallouj, 2002; Tidd & Hull, 2003; Cainelli, Evangelista, & Savona, 2004; Rusanen, Halinen, & Jaakkola, 2014), and form of services (e.g., Berry et al., 2006, 2008; Den Hertog & Bilderbeek, 1999; Kaufmann & Todtling, 2001) affect organizational outcomes. These prior studies recognize the importance of these service innovations' characteristics to customers' satisfaction. However, few researchers have examined the role of service innovation and network relationships with customers in terms of trust, communication, and coordination in customer satisfaction (Irwin, Hoffman, & Lamont, 1998; De Jong et al., 2003; Nysveen & Pedersen, 2007; Fallah & Lechler, 2008; Akgün, Keskin, & Byrne, 2009; Partanen,

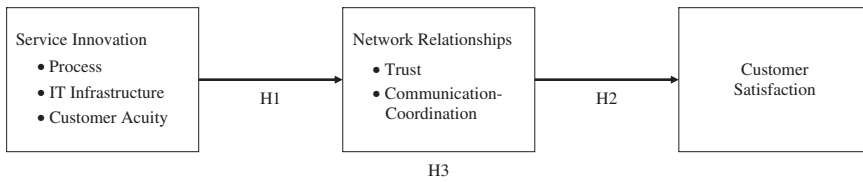


FIGURE 1. RESEARCH FRAMEWORK

Chetty, & Rajala, 2014). Accordingly, this study investigates how service innovation affects customer satisfaction in interfirm cooperation.

This research makes a threefold contribution to the literature. First, this study will enrich the literature on service innovation (Den Hertog, 2000; Menor, Tatikonda, & Sampson, 2002; Van der Aa & Elfring, 2002; Miles, 2005) by accentuating the roles of service innovation and network relationships. Second, it will supplement prior research (Irwin, Hoffman, & Lamont, 1998; De Jong et al., 2003; Nysveen & Pedersen, 2007; Fallah & Lechler, 2008; Akgün, Keskin, & Byrne, 2009) by grounding the service innovation debate in a more robust framework based on the process-oriented view, and will demonstrate that network relationships mediate the effects of service innovation on customer satisfaction. Third, this study will respond to calls for a more differentiated investigation of service innovation (Langerak, Hultink, & Robben, 2004; Desarbo, Benedetto, Song, & Sinha, 2005; Liao, Fei, & Chen, 2007) by investigating the separate effects of process, Information Technology (IT) infrastructure, and customer acuity.

The article is structured as follows. ‘Research background and hypotheses’ section proposes a conceptual framework in Figure 1, which posits that network relationships act as an intermediate factor between service innovation and customer satisfaction. This study will answer the following questions: Can the form of the service innovation provide enough network relationships to benefit customer satisfaction? Do network relationships affect customer satisfaction? How do firm-specific network relationships such as trust, communication, and coordination affect the service innovation process? Therefore, this study will propose two directional relationships (Hypotheses 1 and 2) and one mediated relationship (Hypothesis 3) to generate additional insights into how service innovation influences customer satisfaction through network relationships. This study will use formative constructs to measure service innovation and network relationships. This study will measure service innovation through process, IT infrastructure, and customer acuity (Langerak, Hultink, & Robben, 2004; Desarbo et al., 2005; Liao, Fei, & Chen, 2007; Liao, Chou, & Lin, 2015). Network relationships consist of trust, communication, and coordination (Sivadas & Dwyer, 2000; Wang, Dou, Zhu, & Zhou, 2015). Customer satisfaction is the degree to which the service innovation contributes to customers’ attitude and experience (Dyer & Nobeoka, 2000; Williams & Du, 2014). ‘Research methodology’ section outlines the study’s methodological approach based on a sample of 136 Taiwanese service innovation cases. ‘Results’ section discusses the empirical results. Finally, ‘Discussion and conclusions’ section presents some conclusions and managerial implications.

RESEARCH BACKGROUND AND HYPOTHESES

A process model of how service innovation unfolds performance effects

Several scholars have examined the contribution of service innovation to customer satisfaction (e.g., Agarwal, Erramilli, & Dev, 2003; Manzano, Kuster, & Vila, 2005; Zhou, Yim, & Tse, 2005; Tsou, Chen, & Liao, 2014). However, empirical support for this contribution is still equivocal in service

sectors. For example, some scholars have found support for a direct contribution (e.g., Irwin, Hoffman, & Lamont, 1998; Fallah & Lechler, 2008; Akgün, Keskin, & Byrne, 2009; Chen & Tsou, 2012), while others have not (e.g., Han, Kim, & Srivastava, 1998; Sargeant & Mohamad, 1999; Caruana, Pitt, & Ewing, 2003). In this study, firms should know how to utilize service innovation if they want to enhance their network relationships with their customers during the service innovation period.

Network relationships with the customers is a distinctive and – in some services – a fundamental element of the service process. Service providers, then, must develop not only the service itself, but also the precise manner in which it is delivered to the customers (Johns & Storey, 1998; Blindenbach-Driessen & van den Ende, 2014). As a result of the network relationships between service providers and their customers, some innovation activities adapt services to users' needs, which might in itself be a form of innovation. When service innovation is expensive, sharing the costs is a logical response. Given the level and specificity of the costs attached to the implementation of service innovation, cooperation could be an attractive option for the firms (Mathieu, 2001). Network relationships with customers would be particularly beneficial, because strongly customer-centered approaches are a key feature of servitization (Baines, Lighfoot, Benedettini, & Kay, 2009). Customers are not just provided with products but also with more broadly tailored solutions, typically a mixture of services and goods (Vandermerwe, 1993; East, 1997). Thus, network relationships with customers could be an interesting source of ideas for service innovations. In this study, network relationships are critical in affecting customer satisfaction.

This study proposes the process model of how service innovation reveals the effects of customer satisfaction through specific mediating features of network relationships themselves. Therefore this study posits that the influence of network relationships seems to be more important than service innovation for service providers to create customer satisfaction. In other words, network relationships have to take place before service innovation has any effect on performance. The value of service innovation seems to depend on the mediating process of network relationships that translates service innovation into real performance outcomes.

Service innovation and network relationships

Service innovation comprises the constructs that help organizations provide better services and add value to customers, including a new or considerably changed service delivering process, a well-developed information technology infrastructure and abundant concern and keen acuity for customers (Barras, 1986, 1990; Gallouj & Weinstein, 1997; Tidd & Hull, 2003). Because of the characteristics of service, such as interaction or co-production, there are differences between innovation in the service and in the manufacturing sectors (Mills & Morris, 1986; Gallouj & Weinstein, 1997; Kindström & Kowalkowski, 2014). Service innovation may affect firms' interactions with their clients (Cohen, Cull, Lee, & Willen, 2000). In this study, firms must know how to utilize the service innovation if they are to enhance the network relationships with their clients during the service innovation activities. In this study, network relationships are the ability of interacting units between the focal firm and the clients to adjust to each other based on trust, communication, and coordination (Sivadas & Dwyer, 2000; Cuevas-Rodríguez, Cabello-Medina, & Carmona-Lavado, 2014; Mahr, Lievens, & Blazevic, 2014).

The service innovation process consists of new or more efficient service procedures or operations, or new skills or equipment that can help companies incrementally or radically improve their service productivity, quality, and delivery (Ettlie & Reza, 1992; Gallouj & Weinstein, 1997; Cohen et al., 2000; Liao, Fei, & Chen, 2007). Service innovation is critical in service innovative companies. Through innovative operations or procedures, a company can lower the costs of communication and coordination by decreasing clients' queuing time in service system or by offering modularized or standardized service as options to make it easier for customers to make decisions. Meanwhile, service

innovation process can build clients' trust by quickly responding to customers, offering a more consistent quality of service, or improving the transparency of the service production or delivery processes (Ettlie & Reza, 1992; Cohen et al., 2000; Berry et al., 2006; Reynoso, Kandampully, Fan, & Paulose, 2015). Therefore, I infer that innovation in service process has an important effect on the interaction and trust between corporations and clients.

The information technology infrastructure comprises IT investments, including hardware, software, applications, and interfaces that can facilitate new product or new service development projects, cross-functional integration, technology or market knowledge creation, or internal and external communication (Keen, 1991; Ross, Beach, & Goodhue, 1996; Weill & Broadbent, 1998; Bharadwaj, 2000; Desarbo et al., 2005). The resource-based view asserts the potential of resources and capabilities to create economic value by enabling firms to create and implement strategies (Barney, 2002). With the implementation of IT infrastructures, organizations can offer their customers a variety of products, lower prices, and personalized service (Karakostas, Kardaras, & Papathanassiou, 2005). Information technology alters interaction by eliminating the synchronization of time and place between service providers and clients, while increasing the efficiency and flexibility of communication and coordination (Hipp & Grupp, 2005; Carlborg, Kindström, & Kowalkowski, 2014; Nätti, Hurmelinna-Laukkanen, & Johnston, 2014). Moreover, to meet the growing customer demand for more diverse products or service offerings, and to develop customized or personalized products or services, firms are adopting technologies to customize their services (Pine, 1993). Service providers, such as banks and hospitals, offer services to distant consumers, or extend their service hours by exploiting IT infrastructure, such as the Internet or ATMs (Barras, 1986; Barras, 1990). Other technologies, such as data warehouses and data mining techniques, allow tracing and analysis of individual customer behavior and characteristics, making coordination with customers more feasible (Kalakota & Robinson, 2001). Thus, I argue that the information technology infrastructure enhances and supports network relationships in service activities by increasing convenience, collecting service performance information for management use, and offering extra services.

Customer acuity is the extent to which a firm gathers information about customers' needs to gain insight into their buying process, consults customers to improve the quality of service, to respond to customers' complaints, and involves customers in decisions (Langerak, Hultink, & Robben, 2004; Sawhney, 2006; Tuli, Kohli, & Bharadwaj, 2007). Information about customers' needs and behaviors is beneficial to firms wishing to build an excellent supplier–customer relationship, and then helps firms to gain their customers' trust. Customer information and customer management skills can help firms to discover who their loyal customers are and how best to communicate with them (Buttle & Burton, 2001). Further, customer participation also affects supplier–customer interaction. By embedding customer participation in service development or delivery processes, firms can interact directly with clients and respond more quickly and effectively (Mills & Morris, 1986).

Accordingly, service innovation likely influences firms' network relationships. When firms are aggressive in service innovation, their employees are likely to build interaction networks with clients to create added value during the service innovation period. Conversely, if the firms are passive in service innovation, employees are likely to perceive less need to interact with their clients. As a result, service innovation of process, IT infrastructure, and customer acuity are likely to strengthen firms' network relationships.

Hypothesis 1: Service innovation is positively related to network relationships.

Network relationships and customer satisfaction

Previous studies have found that the related concepts of social capital, cooperation, and interaction can accelerate knowledge access, support innovativeness, and create competitive advantage (Burt, 1992;

Nahapiet & Ghoshal, 1998; Wu & Cavusgil, 2006; Wilkesmann, Wilkesmann, & Virgillito, 2009; Chen, Hsiao, & Chu, 2014). Some researchers suggest that relational capability may enable organizational members' motivation and capability of for service delivery (Ibarra, 1993; Sivadas & Dwyer, 2000; Levin & Cross, 2004; Alam, 2006) and enhance the innovative capability in introducing a new and improved product or service (Huang & Li, 2009). Some studies also propose that interaction is much more important for service companies because of the characteristics of service (Gallouj & Weinstein, 1997; Gallouj, 2002). Owing to their inseparability, services are consumed as they are being produced and involve customer participation (Gallouj, 2002). Therefore, interaction is necessary for service providers when producing and delivering a service target to service clients (Gadrey & Gallouj, 2002). This means that service delivery typically requires close interaction with customers and for service suppliers to develop not only the precise form of the service product, but also the appropriate form of interaction with customers. This study uses Sivadas and Dwyer's (2000) determinants of network relationships (trust, communication, and coordination) and modifies them so that they are suitable for assessing the role of network relationships in service innovation activities.

Trust is a positive expectation of the goodwill and competence of the customers (Nahapiet & Ghoshal, 1998). In a relationship based on trust, service providers, and their customers are more willing to share their knowledge because they trust each other to handle the knowledge carefully and use the knowledge in a way that will benefit the organization (Gulati, 1995; Zaheer & Venkatraman, 1995; Uzzi, 1997; McEvily, Perrone, & Zaheer, 2003). In a trusting relationship, the customers will assume that service delivery is reliable and of high quality. In this way, trust reduces the costs for searching and verifying each other's service knowledge (Larson, 1992; Dyer & Singh, 1998), increasing both the likelihood and efficiency of their subsequent use. Accordingly, a high level of trust is likely to enhance customers' satisfaction.

At the same time, communication, and coordination have positive effects on customer satisfaction. For achieving and sustaining the satisfaction of customers, service providers should know what their customers expect of service delivery. Through communication and coordination, firms can acquire a comprehensive knowledge of customers' service expectations, incorporate these expectations into firms' control system or culture, and maintain consistency between service performance and customers' expectations (Zeithaml, Berry, & Parasuraman, 1988; Parasuraman, 1998; Helena Chiu & Hofer, 2015). Communication and coordination promote a long-term perspective between service providers and their customers (Larson, 1992) and can develop cooperative routines (Uzzi, 1997) that make service delivery easier (Dyer & Nobeoka, 2000). Frequent communications and coordination over time establish rich interaction channels and common understandings and create feedback loops that enhance the customers' ability to evaluate, understand, and use the services (Tortoriello & Krackhardt, 2010).

In this respect, network relationships in terms of trust, communication, and coordination are likely to make positive contributions to customer satisfaction. Through network relationships, service providers strengthen customers' willingness to participate in service delivery and to implement service innovation activities, thus leading to greater customer satisfaction.

Hypothesis 2: Network relationships are positively related to customer satisfaction.

Mediating effects of network relationships

The earlier hypotheses link the relationships among service innovation with network relationships, and network relationships with customer satisfaction. These hypotheses imply that service innovation indirectly influence customer satisfaction through network relationships. Service innovation is a process by which an offering that was not previously available to a firm's customers resulting from the addition of a service offering or change in the service concept that allow for the service offering to be made

available (Barras, 1986, 1990; Gallouj & Weinstein, 1997; Tidd & Hull, 2003). In service delivery, service innovation strengthens a firm's trusting relationships with its customers, increases communication in a shared language and symbols, and establishes a consensus on the operation with their customers through coordination so that the customers and service providers use the same information. Then the established network relationships will facilitate contact reliability and faithfulness in the service delivery process, which help firms learn and acquire service feedback from their customers (Moran, 2005).

In the service delivery setting, service innovation can trigger and increase the network relationships to incorporate potentially valuable service feedback from the customers into the new context of service providers, increase the openness and transparency between service providers and their customers, accelerate the learning of different and complementary information from the customers, and modify the service feedback for their own use (Dyer & Singh, 1998; Dussauge, Garrette, & Mitchell, 2000; Kale, Singh, & Perlmutter, 2000; Rothaermel, 2001). It will therefore increase the willingness and involvement of both service providers and their customers in engaging in service innovation activities and lead to a better outcome.

The foregoing discussion suggests that service innovation promotes network relationships with the customers, which in turn enhances customers' satisfaction. Thus, this study proposes that network relationships mediate the relationships between independent variables of service innovation and the dependent variable of customer satisfaction.

Hypothesis 3: Network relationships mediate the relationship between service innovation and customer satisfaction.

RESEARCH METHODOLOGY

Data collection and sample

This study employs a questionnaire survey approach to collect data for testing the validity of the model and research hypotheses. Variables in the questionnaire include background information, service innovation, network relationships, and customer satisfaction. All independent and dependent variables require 7-point Likert-type responses ranging from 1 = 'strongly disagree' to 7 = 'strongly agree', except for background information. The population for the study is the top 5,000 Taiwanese firms listed in the yearbook published by the China Credit Information Service Incorporation in 2015. Thus, the unit of analysis in this study is the individual firm. This study uses a stratified random sampling method to select 100 firms in each of the five 1,000 levels. This study distributes 500 questionnaires and sends follow-up letters, e-mails, and phone calls to non-respondents 2 weeks after the first mailing to appeal for participation. After the follow-up, an additional questionnaire was dispatched in the 5th week. During the survey, this research repeatedly guaranteed confidentiality and anonymity to reduce the fear of disclosure of company information.

This study uses multiple informants to capture both the independent and dependent variables to minimize common method variance problem. Thus, the research design divides the questionnaire into two parts and different persons answer each part. Leaders who are responsible for service innovation activities fill out independent variables and mediating variables, while top executives (i.e., presidents, vice presidents, directors, or general managers) answer dependent variables and control variables. To ensure the legitimacy of the collected data, this study conducts quality checks to verify the information provided and would only pay for completed survey pairs containing valid data. First, all survey pairs contain identifying codes so that I can subsequently identify the dyads of leaders who are responsible for service innovation activities and top executives. Second, this study compares the handwriting on all questionnaires to ensure that no leaders who are responsible for service innovation activities (or top

executives) have filled out the entire questionnaires. Finally, if I find either multiple leaders who are responsible for service innovation activities (or top executives) questionnaires or missing information, the authors can contact again by e-mail or phone to fill out information. As a result of these quality checks, this study deems 10 pairs of questionnaires either to be questionable or to contain too much missing data and removed them from further analysis. The final sample therefore contained 136 valid and complete questionnaires. It represents a useable response rate of 27.2%.

Subsequently, this study checks the possibility of non-response bias by comparing the characteristics of the respondents to those of the original population sample. The calculated *t*-statistics for the age of the company ($t = -0.908$, $p = .366$), industry affiliation of the company ($t = -0.461$, $p = .646$), capital ($t = -1.457$, $p = .150$), annual sales ($t = 0.930$, $p = .355$), and the number of employees ($t = -0.799$, $p = .427$) are all statistically insignificant, suggesting that there are no significant differences between the respondent and non-respondent groups.

Measures

Customer satisfaction

Based on prior studies (e.g., Dyer & Nobeoka, 2000), customer satisfaction was measured by three items to reflect the extent to which the firm is performing well in terms of customers' satisfaction (Cronbach's $\alpha = 0.82$). The Cronbach's α coefficients in parentheses indicating the internal consistency reliability of the measures in the factors of dependent and independent variables are all above the suggested value of 0.70 (Hair, Anderson, Tatham, & Black, 1998).

Service innovation

In this study, service innovation is defined as new or considerably changed service delivering process, well-developed information technology infrastructure, and abundant concern and keen on customers' acuity which help organizations provide better service and added value to customers. Service innovation construct is assessed with 17 items reflecting the extent to which the firm is performing well in terms of service process, IT infrastructure, and customer acuity. Adapted from Liao, Fei, and Chen (2007), the process factor consisted of four items regarding (1) the company tries different operation procedures to hasten the realization of the company's goals, (2) the company acquires new skills or equipment to improve the manufacturing operation or service process, (3) the company develops more efficient manufacturing process or operation procedure, and (4) the new manufacturing process or operation procedure employed by the company arouses imitation from competitors (Cronbach's $\alpha = 0.72$). Adapted from Desarbo et al. (2005), six items were included in the IT infrastructure factor to indicate (1) new product or new service development projects, (2) facilitating cross-functional integration, (3) facilitating technology knowledge creation, (4) facilitating market knowledge creation, (5) internal communication (e.g., across different departments, across different levels of the organization, etc.), and (6) external communication. (e.g., suppliers, customers, channel members, etc.) (Cronbach's $\alpha = 0.91$). By using the measure originally developed by Langerak, Hultink, and Robben (2004), seven indicators were used to measure the customer acuity factor including (1) the company gathers information about customers' needs, (2) the company has insight into the buying process of customers, (3) the company consults customers to improve the quality of service, (4) our company handles customers' complaints well, (5) our company involves customers in decisions that affect the relationship, (6) our company looks for ways to offer customers more value, and (7) our company treats customers as partners (Cronbach's $\alpha = 0.87$). A principal components factor analysis with varimax rotation is conducted to examine the dimensionality of the measures. The factor analysis supports three factors of service innovation that have eigenvalues >1 and explain

62.64% of the variance. Each item loaded on its appropriate factor with primary loading exceeding 0.58 and cross-loading lower than 0.39.

Network relationships

Network relationships, in this study, refer to an ability of interacting units between the focal firm and the clients to adjust mutually, created through trust, communication, coordination (Sivadas & Dwyer, 2000). Adapted from Sivadas and Dwyer (2000), the trust factor is reflected by four items indicating how much the informants agree with the following statements: (1) the customer feels that he can trust us fully, (2) the customer is convinced that I do not withhold him important information, (3) the customer believes that I do not exploit the benefits of our cooperation to the disadvantage of him, and (4) the customer is convinced that I perform my tasks professionally (Cronbach's $\alpha = 0.80$). I measure the communication–coordination factor by four items: (1) when delivering service, our employees communicate and discuss with customers frequently, (2) when delivering service, our employees have willingness to communicate and discuss with other members in depth, (3) when delivering service, the task assignments of the employees are well planned, and (4) the work procedures and activities are well scheduled (Cronbach's $\alpha = 0.88$). The principal components factor analysis using varimax rotation settled on a two-factor solution, which explains 70.59% of the variance. Results indicate that the two factors are appropriately constructed: eigenvalues for the two factors are greater than 1, primary loadings are greater than 0.67, and cross-loadings are lower than 0.39.

Control variables

This study includes five control variables in the analysis. Firm size and firm age may influence customer satisfaction because different size and age may exhibit different organizational characteristics and resource deployment. Firm age is related, to a certain extent, to the level of experience and managerial competences that an organization has in doing businesses and thus may affect customer satisfaction (Chandler & Hanks, 1994; Bierly & Daly, 2007; Zhan & Luo, 2008). Firm size may influence firm performance because different size may exhibit different organizational characteristics and resource deployment (Blau & Schoenherr, 1971; Aral & Weill, 2007; Weigelt, 2009). I use the three control variables, including capital, annual sales, and employees, to measure the possible firm-size effects. The amount of capital and annual sales were measured in million New Taiwan dollars and the number of employees was calculated as the total number of employees in the firm. In addition, I create one dummy variable to indicate whether a company belonged to manufacturing or other industries (manufacturing industry = 1, others = 0).

Analytic strategy

As suggested by Baron and Kenny (1986), I estimated mediation effects through structural equation modeling techniques. The statistical software AMOS (Arbuckle, 1997) was used. With structural equation modeling, I was able to incorporate multiple indicators (i.e., trust and communication–coordination) of my hypothesized mediator construct directly into the model. This enabled us to at least partially deal with the bias that measurement error can introduce in the estimation of mediated effects (e.g., Judd & Kenny, 1981). Although my sample size was small for structural equation modeling, it is greater than recommended ratio of at least five cases for each variable in the analysis (Falk & Miller, 1992). Further, the variables used in the analysis are approximately normally distributed, which helps speed the approach to normality of the sampling distributions of the parameters (Tanner, 1993).

Measurement model: reliability and validity

Estimating the measurement model includes a confirmatory factor analysis for all of the multi-item scales of the dependent and independent variables simultaneously to provide evidence of both internal consistency and convergent validity (Gerbing & Anderson, 1988). All of the constructs show satisfactory levels of reliability in terms of the composite reliabilities, ranging from 0.72 to 0.91. Convergent validity, the extent to which different means of measuring a construct agree, can be judged by looking at the item loadings. Each loading for each construct significantly relates to its underlying factor, and all of the standardized item loadings are well above the cutoff of 0.50, thus supporting convergent validity.

Discriminant validity, the extent to which a construct differs from others, is assessed for the multi-item dependent and independent scales. This study examines the pairwise discriminant validity by merging the constructs into one and then examines the difference in χ^2 values between the constrained and unconstrained models. The test statistics for each pair are highly significant ($p < .05$), thus suggesting discriminant validity. It is particularly important that discriminant validity is achieved among the constructs for service innovation, network relationships, and customer satisfaction. The significant difference in the χ^2 (service innovation vs. network relationships, $\Delta\chi^2 = 54.9$, $\Delta df = 1$, $p < .001$; service innovation vs. customer satisfaction, $\Delta\chi^2 = 31.8$, $\Delta df = 1$, $p < .001$; network relationships vs. customer satisfaction, $\Delta\chi^2 = 55.5$, $\Delta df = 1$, $p < .001$) indicates pairwise discriminant validity of the constructs (Gerbing & Anderson, 1988). This study also compares the goodness-of-fit indexes between each constrained and unconstrained model and finds the difference to be moderately large, again suggesting sufficient discriminant validity (Bagozzi & Yi, 1990).

RESULTS

In this study, I attempt to understand the relationships among service innovation, network relationships, and customer satisfaction. Table 1 shows the means, standard deviations, and correlations of all measured variables in this study. Prior to the procedure of regression analysis, both independent and mediating variables are mean-centered to reduce the potential problem of multicollinearity (Aiken & West, 1991).

This study uses variance inflation factors to examine the effect of multicollinearity. The values of the variance inflation factor associated with the predictors show a range from 1.09 to 3.86, with a mean of 2.04. The effects of multicollinearity fall within acceptable limits, suggesting no need for concern with respect to multicollinearity (Hair et al., 1998).

Table 2 displays the results of the regression analysis predicting network relationships and customer satisfaction. Overall, it suggests that the variables are largely related in the theoretically predicted manner. Model 1a, 2a, and 3a in Table 2 are the base models that include the control variables. They indicate that this combination of variables does not have significant effects on the dependent variable ($F = 0.26$, $R^2 = 0.01$, $F = 1.29$, $R^2 = 0.06$, and $F = 0.11$, $R^2 = 0.01$). Model 1b and 2b capture the direct effects of service innovation on network relationships. These two models are significant at the $p < .001$ level ($R^2 = 0.27$ and 0.40 , respectively) and explain an additional 26.0 and 34.0 percent of variance over what the control variables alone explain. Coefficients of IT infrastructure are positive and significant ($p < .01$) for both trust and communication–coordination. Similarly, customer acuity has positive and significant effects on trust ($p < .05$) and communication–coordination ($p < .001$). The process factor does not have significant effects on trust and communication–coordination. These findings partially support Hypothesis 1, which states that firms would achieve a higher degree of network relationships if they do more service innovation.

TABLE 1. MEANS, STANDARD DEVIATIONS, AND CORRELATIONS^a

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	VIF
1. Firm age	25.44	23.42	1											1.09
2. Industry type ^b	0.20	0.4	0.07	1										1.23
3. Capital	5.22	1.57	0.2	-0.23	1									2.94
4. Sales	4.65	2.12	0.15	-0.33	0.78	1								3.86
5. Employees	3.87	2.12	0.21	-0.2	0.74	0.78	1							3.06
6. Process	5.55	0.72	-0.03	-0.22	0.12	0.18	0.15	1						1.53
7. IT infrastructure	5.38	0.95	-0.1	-0.21	0.06	0.09	0.09	0.52	1					1.81
8. Customer acuity	5.88	0.69	-0.03	-0.1	0.08	0.02	0.09	0.44	0.50	1				1.72
9. Trust	5.64	0.77	0.01	-0.04	0.03	0.07	0.01	0.33	0.45	0.40	1			1.44
10. Communication-coordination	5.96	0.71	-0.04	-0.2	0.16	0.14	0.10	0.41	0.52	0.54	0.45	1		1.76
11. Customer satisfaction	5.70	0.65	-0.05	-0.03	0.02	0.02	-0.01	0.34	0.42	0.46	0.48	0.49	1	

^aN = 136 (two-tailed test). Correlations with absolute value greater than 0.20 are significant at $p < .05$, and those greater than 0.33 are significant at $p < .01$.

^bDummy variable coded as manufacturing industry, 1; otherwise, 0.

VIF = variance inflation factor.

TABLE 2. RESULTS OF REGRESSION ANALYSES FOR CUSTOMER SATISFACTION^a

Variable	Model 1 (Trust)		Model 2 (communication– coordination)		Model 3 (customer satisfaction)				Sobel test ^b	Sobel test ^c
	1a	1b	2a	2b	3a	3b	3c	3d		
Firm age	0.02	0.06	-0.05	-0.01	-0.05	-0.01	-0.04	-0.03		
Industry type ^d	-0.01	0.1	-0.17	-0.06	-0.01	0.09	0.05	0.08		
Capital	-0.05	-0.07	0.17	0.13	0.04	0.01	0	0		
Sales	0.19	0.25	-0.02	0.08	0.04	0.11	-0.02	0.03		
Employees	-0.1	-0.19	-0.04	-0.14	-0.06	-0.15	-0.01	-0.07		
Process		0.08		0.08		0.1		0.06	0.73	0.84
IT infrastructure		0.31**		0.28**		0.23*		0.08	2.27*	2.33*
Customer acuity		0.24*		0.36***		0.32**		0.17	1.97*	2.78**
Trust								0.32**	0.25**	
Communication– coordination								0.36***	0.24*	
F	0.01	0.27	0.06	0.4	0.01	0.27	0.33	0.37		
R ²	0.26	4.84	1.29	8.76	0.11	4.91	7.41	5.96		

^aN = 136 (two-tailed test).

^bSobel tests of trust.

^cSobel tests of communication–coordination.

^dDummy variable coded as manufacturing industry, 1; otherwise, 0.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Next, I examined how network relationships affects customer satisfaction. Model 3c shows the effect of network relationships on customer satisfaction. It is significant at the $p < .001$ level ($R^2 = 0.33$) and explains an additional 32.0 percent of variance over what the control variables alone explain. The results for trust and communication–coordination in Model 3c are both positive and significant at the $p < .01$ and $p < .001$ level, respectively. The positive and significant coefficients indicate that firms will achieve a higher level of customer satisfaction when they trust their customers, communicate, and coordinate more frequently and effectively with their customers. In summary, two factors of network relationships the expected signs and significant effects on customer satisfaction. Accordingly, Hypothesis 2 is supported.

I adopted a sequential procedure recommended by Baron and Kenny (1986) to analyze the mediating role of network relationships in affecting the relationships between independent variables of service innovation and dependent variable of customer satisfaction. The first step is to examine the effects of the independent variables on the dependent variable. As shown in Model 3b of Table 2, coefficients of IT infrastructure ($p < .05$) and customer acuity ($p < .01$) are positively and significantly related to customer satisfaction. However, process factor is not significant. In the second step, the mediator, network relationships, was regressed on the independent variables, process, IT infrastructure, and customer acuity. The results, shown in Model 1b and 2b of Table 2, indicate that IT infrastructure and customer acuity have significant effects on the mediator, network relationships, but process do not. Third, I examined the relationship between the mediator and the dependent variable. The results, shown in Model 3c of Table 2, indicate that network relationships has a significant effect on customer satisfaction. Finally, I included the mediator, network relationships, in the model to examine whether it reduces the effects of the antecedents to non-significance. Mediation occurs when the presence of the mediator reduces the effects of the antecedents on customer satisfaction and improves the overall fit.

TABLE 3. BOOTSTRAP ANALYSIS TO TEST SIGNIFICANCE OF MEDIATION EFFECTS

Path/effect	Bootstrap estimate		95% Confidence interval	
	β	SE	Bootstrap percentile without bias correction	Bootstrap percentile with bias correction
SI → NR	0.946	0.099	0.766, 1.164	0.763, 1.156
NR → CS	0.724	0.091	0.538, 0.893	0.527, 0.881
SI → CS	0.580	0.109	0.347, 0.777	0.345, 0.775
SI → NR → CS	0.608	0.093	0.418, 0.777**	0.415, 0.776***

Note. $N = 136$.

CS = customer satisfaction; NR = network relationships; SI = service innovation.

** $p = .01$; *** $p = .001$.

The result of Model 3d in Table 2 shows that the presence of the mediator, network relationships, reduces the effects of service innovation are significantly reduced (both of IT infrastructure and customer acuity to non-significance) and improves the overall fit of the model ($\Delta R^2 = 0.19$). The finding partially supports Hypothesis 3 and indicates that network relationships partially mediates the relationship between service innovation and customer satisfaction.

I further tested the significance of the indirect effects of my independent variables on customer satisfaction by Sobel test, which is a more direct test of the mediation hypothesis because this test examines the combined effects of the path between the dependent variable and the mediator and the path between the mediator and the independent variable (Sobel, 1982). As shown in the last two columns of Table 2, I found that IT infrastructure ($p < .05$ for trust and communication-coordination) and customer acuity ($p < .05$ for trust and $p < .01$ for communication-coordination) have significant and indirect effects on customer satisfaction. The results of the Sobel test provide further support to the mediating role of network relationships in affecting the relationships between network relationships and customer satisfaction. Accordingly, Hypothesis 3, which states that network relationships mediates the effect of service innovation on customer satisfaction, is partially supported.

In addition, this study implements the bootstrap analysis, using the graphical interface of Amos 5.0, that Mallinckrodt, Abraham, Wei, and Russell (2006) and Zhao, Lynch, and Chen (2010) recommend to test the mediation effects. This study selects the bootstrap option from the View/Set menu under the Analysis Properties submenu and requests 5,000 bootstrap samples, drawn by default with replacement from the full data set of 113 cases. This study selects both the bias-corrected and uncorrected options with 95% confidence intervals. This study requests bootstrap estimates of indirect, direct, and total effects through the Output submenu. Bootstrapped estimates of the SI → NR, NR → CS, and SI → NR → CS path coefficients are shown in Table 3.

The last two columns of Table 3 show the upper and lower limits for the 95% confidence intervals calculated with both the bias-corrected and uncorrected methods. The first set of confidence intervals shows results of the bootstrapped percentile without bias correction. These values correspond to the 2.5th and 97.5th percentiles from lowest to highest rank-ordered estimates of the indirect effect derived from the 5,000 samples. As the percentile confidence interval does not include 0 and the corresponding p value is .001 for the bootstrap method without bias correction, this study can conclude that the indirect effect is statistically significant. In addition, the results of the bias-corrected 95% confidence intervals are shown in the last column of Table 3. As this assumed more accurate confidence interval (0.415, 0.776) also excludes 0 and the corresponding p value is .001 for the

bias-corrected bootstrap method, this study concludes that the indirect effect of service innovation on customer satisfaction through the mediator of network relationships is statistically significant. Accordingly, the results of the bootstrap analyses further support Hypotheses 3.

In accordance with the four basic steps to establish mediation effects proposed by the authors, and to test the SD, the researcher fit the research model to the data. The χ^2 statistic for the combined model is insignificant ($p > .05$). The goodness-of-fit index (GFI = 0.98), adjusted goodness of fit index (AGFI = 0.96), and root-mean-square residual (RMR = 0.02) all indicate an acceptable fit. The root-mean-square error of approximation is a respectable 0.00. These fit statistics are acceptable for a complex and multidimensional model.

DISCUSSION AND CONCLUSIONS

Service innovation plays a key role in developed economies. It has become the main driver of the economy and the major contributor to growth in productivity. This study presents a conceptual model to examine the role of network relationships between service innovation and customer satisfaction. The results provide strong support for the arguments that service innovation and network relationships facilitate customer satisfaction. Service innovation has significant but indirect effects on customer satisfaction, and network relationships have significant and direct effects on customer satisfaction. More specifically, service innovation is positively related to network relationships, which is linked positively to customer satisfaction. These findings highlight the critical roles of service innovation and network relationships in the process of service delivery.

This article has important implications for both scholars and practitioners and opens many avenues for further explorations in the field.

Implications for practice

The findings and context have crucial managerial implications for practitioners. Service innovation can be viewed as a chain or constellation of activities that allows the service to function. It is also the presence of the customer in the production process. However, without the customer, service innovation cannot take place, because it requires customer interaction with the production of the service provider.

First, this study suggests that it is appropriate for firms to develop their service innovation by coordinating their process with their IT infrastructure and customer acuity. It is critical for the firms to utilize their IT infrastructure and customer acuity to strengthen mutual trust, communication, and coordination, and thereby lead to customer satisfaction. Second, this study has provided evidence that service innovation influences customer satisfaction via intermediate activities (i.e., network relationships). An understanding of the key network relationships features affecting customer satisfaction will put firms in a better position to develop strategies for service innovation and consequently achieve superior customer satisfaction. Firms should continue to emphasize service innovation to retain customers. They should pull more innovative resources such as IT infrastructure and customer acuity into service operations, and foster closer relationships with customers to identify market opportunities and design new services. Third, firms must implement service process innovation in a way that can provide higher-quality services or products, shorten service delivery time and improve efficiency, develop and promote new services or products, and manage customer knowledge and information that would create greater customer value or attain superior performance.

However, this research does not show that the process significantly influences customer satisfaction. It may be that firms should change or redesign service processes so that data about customer preferences can be collected easily and quickly. In other words, the implementation of process innovation

practices that support customized products or services requires a flexible service process modularity to understand the specific needs of customers. Under such conditions, process innovation without customer-oriented service practices makes only a marginal improvement in the firm's performance. Therefore, this study could not identify the effect of process on the customer satisfaction.

Finally, this study suggests the centrality of network relationships in the relationship between service innovation and customer satisfaction. Awareness of this relationship could help firms facilitate network relationships by assuming leadership of customer-oriented practices. Thus, to enhance the effect of service innovation on customer satisfaction, managers need to invest in service innovation activities, especially in IT infrastructure and customer acuity, and encourage employees to commit to build added value interactions with firm's customers. So when a firm engages in service innovation, what deserves managers' attention are the firm's information technology system and customer acuity. Through a well-developed IT infrastructure and customer acuity, organizations will get more network relationships, which then will lead to better performance. According to my results, by building good relationships with customers by earning their trust, remaining in communication and by coordinating the service process, a firm will gain a competitive advantage and good customer satisfaction.

Theoretical implications

The findings of this study contribute to the theoretical development of a conceptual model for explaining the interrelationships among service innovation, network relationships, and customer satisfaction. Prior studies have emphasized the effects of service characteristics (e.g., Evangelista & Sirilli, 1995; Djella & Gallouj, 1999; Gebauer & Fleisch, 2005; Gebauer, Fleisch, & Friedli, 2005; Love & Mansury, 2007; Mansury & Love, 2008), service taxonomy and models (e.g., Den Hertog & Bilderbeek, 1999; Fitzsimmons & Fitzsimmons, 2006; Lay et al., 2010), close interactions (e.g., Sirilli & Evangelista, 1998; Gadrey & Gallouj, 2002; Tidd & Hull, 2003; Cainelli, Evangelista, & Savona, 2004) and form of services (e.g., Berry et al., 2006, 2008; Den Hertog & Bilderbeek, 1999; Kaufmann & Todtling, 2001) on service innovation activities. However, few studies in the literature have examined the interrelationships among service innovation, network relationships, and customer satisfaction (Tidd & Hull, 2003; Cainelli, Evangelista, & Savona, 2004). This deficiency is serious because of the increasing importance of service innovation to the competitive advantages of the firms. Accordingly, this study reinforces the conceptual model and hypothesizes the mediating role of network relationships between service innovation and customer satisfaction. The second contribution of this paper is that, based on process-oriented view, this study hypothesizes that network relationships mediate the effects of IT infrastructure and customer acuity on customer satisfaction. The results suggest that network relationships are necessary conduits to enhanced customer satisfaction, and highlight the critical roles of IT infrastructure and customer acuity for the firms involved in service innovation activities. The third contribution of this study is the derivation of empirical support for the model's prediction by using data from actual partnerships. The empirical results of Sobel's (1982) test, Baron and Kenny's (1986) procedure, and the bootstrap analysis support the mediating role of network relationships between service innovation and customer satisfaction. The empirical evidence presented in this study compensates for the lack of empirical examination of the roles of service innovation and network relationships in service innovation.

Limitations and future research

The findings of this study should be interpreted with caution in light of several limitations. The first is the use of a cross-sectional research design. Although the results are consistent with theoretical reasoning, the cross-sectional design may not rule out causality concerning the hypothesized relationships.

Future researchers may address this issue by using case studies or longitudinal studies to investigate the impact of service innovation on specific organizations. As an alternative, some studies can be done only in the manufacturing sector to understand how the implement of service innovation affects the manufacturing firms.

The second limitation is that this study is based on self-reported data. In that sense, this study is not different from the previous literature. However, in my study, the likelihood of common method variance is low because the dependent variable was obtained from a variety of sources. In addition, we conducted standard *t*-tests to rule out non-response bias. However, the low return rate of the survey remains a potential limitation because the phenomenon may exhibit greater heterogeneity than suggested by my data.

Finally, this study investigates only service providers. Service delivery involves at least two organizations, so the resources and capabilities of the service providers and their customers will also affect customer satisfaction. This one-sided investigation may lead to possible bias and to the neglect of some important facts since the customers are not able to express opinions on the service innovation activity. Future research on service innovation can investigate both the service providers and their customers, to avoid the possible bias and obtain complete information about service innovation activities.

In addition, for the model of service innovation, future studies can test and modify the framework or consider other variables to measure service innovation to offer more detailed and more general explanations. Different content and combinations of service innovation may lead to different results. In addition, the use of objective performance indicators such as sales may lead to different research results. Future researchers also could use a covariance structure model that would allow the simultaneous exploration of both the direct and the indirect relationships between the variables in the study.

To conclude, service innovation is an important vehicle for firms to improve their competitive advantages. The viewpoints proposed in this study highlight the mediating role of network relationships in the relationships between service innovation and customer satisfaction. The IT infrastructure and the customer acuity of service innovation can deliver better customer satisfaction, but do so primarily through network.

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