

# Effects of ICT Service Innovation and Complementary Strategies on Brand Equity and Customer Loyalty in a Consumer Technology Market

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This paper examines the effects of information and communication technology (ICT) service innovation and its complementary strategies on brand equity and customer loyalty toward ICT service providers. We draw from research on brand equity and customer loyalty, ICT innovation management, and strategy complementarity to propose a model that includes new constructs representing ICT service innovation, i.e., service leadership, and its two complementary strategies, i.e., customization-personalization control and technology leadership, and how their interactions influence customer loyalty through customer-based brand equity. We test our model using data from an online survey of 1,210 customers of mobile data services. The results show that service leadership and customization-personalization control have significant direct impacts on ICT service providers' brand equity. Moreover, when either the level of technology leadership or the level of customization-personalization control is high, the impact of service leadership on brand equity is enhanced. In turn, brand equity has significant impacts on consumers' affective loyalty and conative loyalty, but not on cognitive loyalty. Our study contributes to the literature on service management and service science, and in particular to the management of ICT service innovation in a consumer technology market.

*Keywords:* ICT service innovation; ICT service management; service leadership; technology leadership; customization; personalization; brand equity; customer loyalty; strategy complementarity; mobile data services

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## 1. Introduction

Information and communication technologies (ICTs) play a key role in today's service economy (Rai and Sambamurthy 2006). ICT services have become the main driver of productivity and economic growth in the world economy (Bilbao-Osorio et al. 2013). Gartner estimates that the worldwide ICT service market will grow steadily and reach about US\$ 3 trillion by 2015 (Gordon 2012). ICT service innovation has become a high priority for companies to gain competitive advantage in an environment of rapid technology evolution (Wu 2014). Consequently, the management of ICT service innovation is a major challenge to ICT service providers in terms of formulating and deploying strategies (see Rai and Sambamurthy 2006).

One particularly important strategic issue facing ICT service providers relates to building customer

loyalty in a competitive market with rapid technology evolution (Rust and Miu 2006). Rapid technology evolution has accelerated the rate of service innovation that intensifies the level of competition in the ICT service market. Advances in ICTs are allowing companies to introduce new services that are of high quality, of great diversity, and customizable, thus attracting customers away from their original service providers and leading to high customer churn rates. This is especially true for ICT service providers in the consumer technology market (Gupta and Ingelbrecht 2009, Nokia Siemens Networks 2010). For instance, mobile service providers keep introducing new technologies in order to seize market share from their competitors. They have introduced four generations of technology platforms—i.e., 2G, 2.5G, 3G, and 4G (G for generation). Each new generation enabled a

service portfolio of greater variety and superior performance compared to its predecessor (Thong et al. 2011, Xu et al. 2010). For example, compared to the previous technology generations, 3G provided consumers with a portfolio of new services, such as video streaming, mobile games, and multimedia messaging service (MMS). The current 4G technology supports new services, such as high-definition TV, video conferencing, and cloud services, enabled by even faster network speed and broader network coverage. Attracted by the constant service innovations from competing service providers, consumers tend to switch service providers frequently which undermines the base of loyal customers (Gupta and Ingelbrecht 2009, Nokia Siemens Networks 2010). As the unit cost of customer retention is much lower than that of customer acquisition, ICT service providers can enjoy a competitive advantage by maintaining and expanding a loyal customer base. Thus, there is a pressing need for ICT service providers to understand the connection between service innovation and customer loyalty.

An important mechanism underlying the impacts of ICT service innovation on customer loyalty is the formation of customer-based brand equity, defined as a consumer's personal identification with the focal brand and the brand's relevance to the consumer's personal situation (Johnson et al. 2006). In the ICT service marketplace, consumers are users of branded ICT services. Moreover, as ICT services have become ubiquitous and integrated into every aspect of consumers' personal and social lives (Hoffman et al. 2004), an ICT service provider's brand bears personal and social meaning for consumers (Dobni and Zinkhan 1990, Escalas and Bettman 2005). ICT service innovation can potentially generate impacts on more direct business outcomes, i.e., brand equity and customer loyalty, than technology acceptance and use (e.g., Venkatesh et al. 2003, 2012), which has been the focus of much prior information systems (IS) research.

IS research has examined a number of issues concerning ICT service management, such as the mechanism to generate timely information services for diverse users (e.g., Konana et al. 2000) and the design and management of customer-centric websites (e.g., Albert et al. 2004). These studies have mainly focused on the organizational context without considering the branding of ICT services in the consumer market. IS research has also examined a number of strategies related to ICT service innovation, e.g., being early adopters of new technology (e.g., Dos Santos and Peffers 1995), "content is king" (e.g., Dewan et al. 1998), and providing customization and personalization for users (e.g., Kamis et al. 2008, Tam and Ho 2005, 2006). However, these studies either examined business outcomes at the organization level (e.g., Dewan et al. 1998, Dos Santos and Peffers 1995), focused

on individual acceptance (e.g., Kamis et al. 2008), or choice among alternative offers (e.g., Tam and Ho 2005, 2006). Besides the increased complexity in strategic options, there is a lack of research on the interactions among strategies in influencing direct business outcomes at the individual level, such as customer-based brand equity and customer loyalty. Although the marketing discipline has a long history of studying service marketing (e.g., Rust and Miu 2006), strategic brand management (e.g., Farquhar 1989, Keller 1993) and customer loyalty (e.g., Oliver 1980, 1999), the interrelationships among technology-based service innovation, branding, and customer loyalty are less explored (Bitner and Brown 2006, Parasuraman and Grewal 2000). Thus, an examination of the interactions between ICT service innovation and other strategies, their impacts on direct business outcomes, and the underlying mechanism will provide both theoretical and practical contributions to service science in general and ICT service innovation management in particular (Chesbrough and Spohrer 2006, Rai and Sambamurthy 2006). Against this backdrop, this research focuses on the synergistic effects, i.e., complementarities, of service leadership, customization-personalization control, and technology leadership on customer-based brand equity that in turn influences customer loyalty. In particular, we have two objectives:

(1) to develop a model of the impacts of ICT service innovation and its complementary strategies on customer loyalty through customer-based brand equity; and

(2) to empirically test the proposed model in the mobile data services (MDS) marketplace.

## 2. Theoretical Foundations

There are three broad areas of research that are relevant to our study: (1) ICT innovation management (e.g., Gawer and Cusumano 2002, Meyer and DeTore 2001); (2) strategy complementarity (e.g., Milgrom and Roberts 1990, 1995); and (3) customer loyalty and brand equity (e.g., Keller 1993, Oliver 1999). Below, we discuss the roles they play in our model development and identify the gaps in the prior literature.

### 2.1. Strategic Management of ICT Innovation

We focus on strategies adopted by ICT service providers<sup>1</sup> to develop and deliver new services to

<sup>1</sup> In the current research, ICT service providers refer to businesses that integrate their own service offerings and those provided by third-party vendors to function as the service portal for consumers. In the past, mobile service providers mainly served this role, e.g., NTT DoCoMo. Recently, some device manufacturers have entered this market, e.g., Apple and other smartphone manufacturers. Our model applies to both types of ICT service providers.

the consumer market. Although prior IS research has identified a number of key strategies related to ICT service innovation, they were examined on an individual basis in separate studies. Initially, technology itself was regarded as a source of competitive advantage (e.g., Mata et al. 1995) and being the first/early mover in some markets was found to lead to improved business performance (e.g., Dos Santos and Peffers 1995). As ICT became more ubiquitous and competition intensified, the strategic role of the technology alone was challenged and ICT service providers were regarded as utility vendors (e.g., Carr 2003). Accordingly, the strategic focus shifted to the variety and quality of the services, enabled by technology advancement (e.g., Rai and Sambamurthy 2006), resulting in views like “content is king” (see Dewan et al. 1998). A variety of services were offered by ICT service providers in order to discover the “killer application” that could attract more traffic and consumer spending (Dewan et al. 1998). As the variety of services increased dramatically, customization and personalization came into play to attract consumers by better matching their idiosyncratic needs with diversified services (e.g., Gilmore and Pine 1997, Kamis et al. 2008, Tam and Ho 2005, 2006). With the increased complexity in strategic options, issues arise about both the differential and interaction effects of these strategies on consumers.

**2.1.1. ICT Service Innovation and Its Complementary Strategies.** We examine ICT service innovation and its two complementary strategies, namely, technology leadership and customization-personalization control. ICT services refer generally to ICT-based provider-client interactions that create and capture direct value (IBM Research 2004). We define *service leadership* as consumers’ perceptions of an ICT service provider’s service innovation efforts. Specifically, service leadership corresponds to the strategy of introducing new services consistently and being a leader in terms of service variety. New and/or upgraded services, enabled by the technology advances, are offered under ICT service providers’ brands and advertised in the mass media. In turn, consumers learn about the service innovation efforts by different ICT service providers and form their beliefs about the service leadership of different service providers. For instance, Hutchison Telecommunications introduced new services, such as video phone calls, multimedia messaging, and mobile TV services, ahead of its competitors in Hong Kong. The new services were heavily advertised in the mass media through which consumers were made aware of the service leadership of Hutchison Telecommunications.

We define *technology leadership* as consumers’ perceptions of an ICT service provider’s technology innovation efforts. Service innovation in general is

supported by the development and introduction of new core technologies as the service platform (Gawer and Cusumano 2002, Meyer and DeTore 2001). In the context of MDS, some examples of platform technology innovations include the evolution of the mobile telecommunication network from 2G to 4G and the evolution of mobile phones’ user input interface from a keypad design to a touch-screen design. Technology leadership refers specifically to the strategy of early introduction of technology innovations to the market. There are usually news, reports, and announcements about innovations in the service technology platform in the ICT service providers’ marketing campaigns. Consumers can then learn about the technology innovation efforts undertaken by different ICT service providers and form their beliefs about the technology leadership of their ICT service providers. For example, Hutchison Telecommunications was the first to introduce 2G and 3G in Hong Kong, whereas CSL Hong Kong was the first to introduce 4G. Upon introduction of its newest technology platforms, the companies, via mass marketing efforts, made consumers aware of the ICT service provider’s technology leadership.

The distinction between service leadership and technology leadership lies in the difference between service and platform technology (see Xu et al. 2010). ICT services provide direct value to consumers (IBM Research 2004). For instance, consumers can improve their effectiveness and efficiency (deriving utilitarian value) when they use a mobile navigation service to find directions. The underlying technology that supports the service (i.e., GPS) constitutes a component of the service platform. A platform includes a set of subsystems and interfaces that provide the basic technological architecture for a series of derivative products/services (McGrath 2001, Meyer and Lopez 1995). Platform technologies play the supportive and enabling role in the service interaction process (IBM Research 2004). However, technology alone does not directly provide value to consumers. For example, iPhone applications can provide services, whereas the iPhone device, with the iOS and touch-screen interface, serves as the platform technology. The touch-screen interface alone does not provide any direct value to consumers, but it supports their interactions with the services, e.g., using the touch screen to select a destination on the map when using a mobile navigation service. Thus, GPS and the touch-screen interface are technology innovations that support service innovation—in this case, a mobile navigation service.

Finally, we identify a third key strategy, i.e., *customization-personalization control*, that is relevant to ICT service innovation. Customization is the strategy that allows consumers to tailor products and services according to their preferences (Gilmore and Pine 1997).

Customization emphasizes customer-initiated actions to control the final service portfolio (e.g., Dellaert and Stremersch 2005). In contrast, personalization emphasizes service providers' active recommendations that fit consumers' preferences (e.g., Tam and Ho 2005). Customization and personalization mechanisms adopted by service providers have been found to influence various aspects of consumer psychology, including information processing and decision making (e.g., Tam and Ho 2006). Although there is a difference in the initiating party between customization and personalization, they both serve the purpose of adapting content or services to meet the specific needs of consumers and to maximize business opportunities (Ho and Bodoff 2014). Thus, customization can be viewed as a user-driven approach to personalization (Tam and Ho 2006). We incorporate these two mechanisms as the components of a single construct—customization-personalization control as perceived by consumers—because from the consumers' point of view both serve the same purpose of matching services to consumers' idiosyncratic needs. For instance, in the MDS marketplace, service providers offer a variety of customization-personalization controls to their customers, such as ringtone download, ringtone customization, and SMS recommendation of new services. Another example is Apple's App Store where consumers can choose apps from the top hit lists, by categories, or view recommendations by the Genius function in the "Featured" category.

**2.1.2. Strategy Complementarity.** We define strategy complementarity as the synergy among different strategies adopted by an organization. The concept of complementarity can be traced back to microeconomics. Goods or services are considered complements if they increase consumer utility only when consumed together. Strategy complementarity refers to the enhancing effect of one strategy on another to improve organizational performance (e.g., Milgrom and Roberts 1990). Further, strategy complementarity is associated with but is distinct from the notion of strategic fit (e.g., Miles and Snow 1978). Research on strategic fit has distinguished among four generic strategies, namely, prospecting (innovative and exploratory), defending (narrow and focused), reacting (waiting for environmental cues), and analyzing (a mix of prospecting and defending). The focus of strategic fit is the alignment of internal factors, such as organizational structure and business processes, with the environmental factors and the chosen positioning strategy. However, strategy complementarity goes beyond alignment and focuses on the enhancing effect of one strategy on another in improving business performance (e.g., Milgrom and Roberts 1990).

This enhancing effect has been conceptualized as the synergistic gains in organizational performance

generated from complementary strategies and has been studied in different disciplines (e.g., Aaker and Keller 1990, Black and Boal 1994, Milgrom and Roberts 1990). In the economics literature, Milgrom and Roberts (1990, 1995) suggested that complementarities among technology innovation, marketing, and other strategies, such as supply chain management, can generate positive effects, i.e., mutually enhancing or synergistic effects, on firm performance. For instance, the complementarity between the flexible multiproduct manufacturing technology that facilitates product innovation (i.e., production strategy) and marketing strategies that aim to satisfy customer needs in a timely and efficient manner increases firms' profits to a greater extent than when each type of strategy is adopted alone (Milgrom and Roberts 1995). Research on strategic management has also identified the role of interdependence between strategic factors, such as the enhancing effect of one type of strategic resource on another, in achieving sustainable competitive advantage (e.g., Black and Boal 1994). In the marketing literature, individual consumers have also been found to be able to perceive and evaluate the synergy of brand extensions (Shine et al. 2007), which refer to the strategic use of an established brand name to enter a new market (Aaker and Keller 1990). For instance, iPhone and iPad are brand extensions of the established Apple brand in the mobile device market. Research has found evidence of the mutually beneficial effects between the established brand and its extensions (Keller and Aaker 1992) and between two complementary brand extensions (Shine et al. 2007). Likewise, in IS research, complementarities have been identified across the hierarchy from hardware to services (see Xu et al. 2010). This line of research supports the synergistic effects of branding strategies on individual consumers' brand evaluation and subsequent decision making.

We adapt the notion of strategy complementarity to the individual consumer level in the context of ICT service innovation. Specifically, we propose that when ICT service innovation is complemented by technology leadership and customization-personalization control, as perceived by consumers, synergistic effects on the customer-based brand equity will be achieved that in turn influences customer loyalty.

## 2.2. Customer Loyalty and Brand Equity

**2.2.1. Customer Loyalty.** The marketing literature on customer loyalty has a long history, dating back to studies on customer satisfaction (e.g., Oliver 1980). Our examination of the literature, including articles in the leading marketing journals,<sup>2</sup> revealed that customer/brand loyalty has been conceptualized in

<sup>2</sup> Searching for "loyalty" as a word in the title resulted in approximately 100 articles in the following five journals: *Journal*

different ways. The definition of customer loyalty has evolved from a behavioral definition, e.g., repeat-purchase behavior (Brown 1952) to more psychological ones based on either the attitude-behavior framework (e.g., Day 1969) or the cognition-affect-conation framework (e.g., Oliver 1997). Day (1969) composed a brand loyalty index based on both probability of purchase and brand attitude. Oliver (1997, p. 392) defined customer loyalty as “a deeply held commitment to rebuy or repatronize a preferred product or service consistently in the future, despite situational influences and marketing efforts having the potential to cause switching behavior.” This conceptualization was further extended to include the act of “repetitive same-brand or same brand-set purchasing” Oliver (1999, p. 34). Four phases of customer loyalty have been identified, namely, cognitive loyalty, affective loyalty, conative loyalty, and action loyalty (Oliver 1999). Cognitive loyalty is a consumer’s preference for one brand over its alternatives and is based on information about the attributes of a brand, such as performance and price. Affective loyalty is consumers’ liking or attitude toward the brand and is formed based on cumulatively satisfying usage experiences. Conative loyalty is a consumer’s desire or intention to repatronize the brand, i.e., loyalty intentions. Finally, action loyalty is the conversion of loyalty intentions into action (e.g., repeat purchase) with a willingness to overcome obstacles that prevent the act.

Besides the differences in conceptualization as outlined above, customer loyalty has been measured as a unidimensional construct as well as a multidimensional construct in a variety of research contexts. In the stream of behavioral conceptualization, customer loyalty has been mainly measured as a unidimensional construct with behavioral measures, such as repeat purchase (e.g., Fader and Schmitlein 1993) and the percentage of spending on a particular store brand (e.g., Ailawadi et al. 2008). An exception is Sheth (1968) where a multidimensional behavioral measure of brand loyalty was developed to incorporate the possibility of a consumer’s varying degrees of loyalty to a number of brands. In the attitude-behavior stream, a number of studies adopted a unidimensional scale that consisted of items for both attitudinal loyalty and behavioral loyalty (e.g., Melnyk et al. 2009, Yim et al. 2008). Some studies measured attitudinal loyalty and behavioral loyalty with separate scales and specified them as two

different variables in the model (e.g., Chaudhuri and Holbrook 2001, Chiou and Droge 2006). Finally, most of the papers following the cognition-affect-conation framework focused on the conative loyalty, i.e., loyalty intention, and measured this construct with a unidimensional scale (e.g., Palmatier et al. 2007, Sirdeshmukh et al. 2002, Zeithaml et al. 1996). In contrast, both Evanschitzky and Wunderlich (2006) and Harris and Goode (2004) measured all four phases of customer loyalty with separate scales. Evanschitzky and Wunderlich (2006) specified the four phases of customer loyalty as different variables in their model, whereas Harris and Goode (2004) specified a second-order factor of overall customer loyalty with each of the four phases as dimensions. The measurement scales for each phase, however, were context specific. When measuring cognitive loyalty, Evanschitzky and Wunderlich (2006) used consumers’ perceived performance of five different attributes of retail outlets, i.e., assortment, environment, price, salespersons’ performance, and service, whereas Harris and Goode (2004) used consumers’ preference for the focal service provider over its competitors. When measuring affective loyalty, overall satisfaction (e.g., Evanschitzky and Wunderlich (2006) and liking (e.g., Harris and Goode 2004) were used. Evanschitzky and Wunderlich (2006) followed Zeithaml et al. (1996) to measure conative loyalty, whereas Harris and Goode (2004) adapted the scale in Oliver (1997). Finally, action loyalty was measured by purchase frequency in Evanschitzky and Wunderlich (2006) and by continuance in Harris and Goode (2004). In this work, we will adapt Oliver’s (1997) definition of customer loyalty to the ICT service innovation context and define it as a deeply held commitment to repatronize an ICT service provider consistently in the future. We include three phases of customer loyalty, i.e., cognitive loyalty, affective loyalty, and conative loyalty, in our model.<sup>3</sup>

**2.2.2. Customer-Based Brand Equity.** Brand equity has been defined in a number of ways in the marketing literature (see Aaker 1991, Erdem and Swait 1998, Keller 1993). In general, brand equity is the incremen-

<sup>3</sup> We do not include action loyalty in our research model for two reasons: (1) action loyalty is essentially the actual behavior following conative loyalty—i.e., behavioral intention (Oliver 1999) and research has demonstrated that intention is predictive of behavior (e.g., Armitage and Conner 2001); and (2) we conducted the empirical study in the MDS market where service contracts are usually renewed biannually, thus being subject to significant practical constraints in terms of meaningfully measuring action loyalty within a narrow window of time, with consumers more likely to act (e.g., switch) at the time of contract renewal and not whenever they choose.

of Marketing, *Journal of Marketing Research*, *Journal of Consumer Research*, *Journal of the Academy of Marketing Science*, and *Journal of Retailing*. When the search was expanded to include loyalty as a keyword or as a word in the abstract, the number of articles more than doubled. We also expanded our search to include other sources, such as the *Journal of Advertising Research* and *Journal of Service Research*.

tal utility or extra value with which a brand endows a product/service—i.e., it is the value a brand adds to a product or service in comparison with the same product/service without the brand name (Keller 1993, Simon and Sullivan 1993). Our review of the marketing literature on brand equity reveals three streams of studies:<sup>4</sup> (1) sources/formation of brand equity, such as the marketing mix (Yoo et al. 2000) and intergenerational influences (Moore et al. 2002); (2) impacts of brand equity on marketing/financial outcomes, such as consumer loyalty (Johnson et al. 2006), transfer of brand equity (e.g., Martin and Stewart 2001), and a firm's market value (Rego et al. 2009); and (3) measurement of brand equity (e.g., Ailawadi et al. 2003, Chan and Srinivasan 1994). We focus on the ICT service innovation context in this work to (1) theorize that ICT service innovation and its related strategies can be the source of customer-based brand equity, (2) examine the impacts of brand equity on the three phases of customer loyalty, and (3) adopt the notion of personal identification for brand equity and the corresponding measurement.

Customer-based brand equity stems from “the differential effect of brand knowledge on consumer response to the marketing of a brand” (Keller 1993, p. 8). As consumers are the ultimate users of the branded services/products, their brand knowledge is the source and foundation of brand equity (Keller and Lehmann 2006). Brand equity does not exist in a vacuum. Rather, it is the accumulated influence of a company's strategic actions, e.g., service innovation, on consumers' knowledge about a brand (Keller 1993). Keller (1993, 2003) focused on the different types of consumer brand knowledge, such as brand awareness and associations, that lead to the differential brand evaluation. Aaker's (1991, 1996) conceptualization consists of a much broader spectrum of brand equity components, such as loyalty, quality, value, and brand personality, in addition to awareness and associations. Finally, Johnson et al. (2006) conceptualized brand equity as a consumer's personal identification with the brand and the brand's relevance to a consumer's situation, which goes beyond the effects of performance/instrumental values of the product/service.

There are also different measurements of customer-based brand equity and they tend to be context specific (e.g., Arnett et al. 2003, Jaju et al. 2006, Luo et al. 2010). Following the general notion of the extra

value that a brand endows a product/service, behavioral measures have been proposed, such as brand-quality association (van Osselaer and Alba 2000, 2003) and the difference between an individual consumer's overall brand preference and the consumer's brand preference on the basis of objectively measured product attribute levels (Park and Srinivasan 1994). There are multi-item scales for both multidimensional and unidimensional conceptualizations of brand equity (e.g., Johnson et al. 2006, Yoo et al. 2000). In the multidimensional stream, most of the measures integrated the conceptualizations from both Keller (1993) and Aaker (1991, 1996) and chose the dimensions according to their research contexts. For instance, Yoo et al. (2000) specified three dimensions of brand equity—i.e., perceived quality, brand loyalty, and brand awareness and associations. In the unidimensional stream, Rego et al. (2009) followed the original awareness-association conceptualization (Keller 1993) and measured brand equity as a unidimensional construct with two components—i.e., brand familiarity and brand associations. Johnson et al. (2006) conceptualized and correspondingly operationalized brand equity with items that reflected consumers' personal identification and relevance with the brand, such as the degree to which the brand fits a customer's personality and lifestyle.

We adapt the work of Johnson et al. (2006) on brand equity to the context of ICT service innovation. Johnson et al. (2006) adopted a different conceptualization of brand equity compared to other more general frameworks (e.g., Aaker 1996, Keller 1993).<sup>5</sup> We adopt the approach of Johnson et al. (2006) because it is a good fit to our context. First, as discussed earlier, ICT services play an important role in consumers' personal and social lives (Hoffman et al. 2004). Conceptualizing brand equity as consumers' personal identification and relevance with an ICT service provider's brand provides a better characterization of this role.

<sup>5</sup> The typical conceptualization of brand equity based on the general frameworks incorporates a number of intermediate modalities like brand awareness and associations (e.g., Keller 1993) and others like quality, price, or brand personality (e.g., Aaker 1996). The conceptualization of brand equity by Johnson et al. (2006) mainly focuses on the notion of degree of a consumer's personal identification and relevance with the brand and thus reflects the outcome of the intermediate modalities related to the consumer's self-identity and social identity, such as brand personality and brand associations relevant to the consumer's social roles. Although the conceptualization by Johnson et al. (2006) can be argued as being narrower compared to other conceptualizations, it is essentially consistent with the fundamental notion of brand equity—i.e., the extra value added by the brand to a product/service when compared to the same product/service without the brand name (Simon and Sullivan 1993). This is because Johnson et al. (2006) focus on the social value endowed by the brand that is beyond the instrumental value of the product/service, which are based on performance, quality, price, etc., of the product/service.

<sup>4</sup> Searching for “brand equity” as a word in the title, as a keyword, or in the abstract resulted in approximately 50 articles in the following five journals: *Journal of Marketing*, *Journal of Marketing Research*, *Journal of Consumer Research*, *Journal of the Academy of Marketing Science*, and *Journal of Retailing*.

Second, Johnson et al. (2006) studied the evolution of loyalty intentions in the life cycle of innovations or new-to-market offerings and hypothesized the effect of brand equity on customer loyalty. Our research shares a similar research context as we study the impacts of ICT service innovation and its complementary strategies on brand equity that in turn is expected to influence customer loyalty. Finally, the conceptualization of brand equity by Johnson et al. (2006) can provide insights into the social mechanisms underlying the impacts of ICT service innovation on customer loyalty. According to Oliver (1999), customer loyalty is ultimately determined by his or her individual and social integration with the brand, i.e., the integration of the brand into the consumer's self-identity and the consumer's social identity. The conceptualization of brand equity by Johnson et al. (2006), i.e., a consumer's personal identification and relevance with the brand, is an appropriate characterization of this social mechanism.<sup>6</sup>

### 3. Model Development

Figure 1 presents our research model and the hypotheses regarding the synergistic impacts of service leadership, customization-personalization control, and technology leadership on brand equity that in turn influences customer loyalty.<sup>7</sup> We first theorize how brand equity is related to the three phases of customer loyalty. Service leadership and customization-personalization control are then hypothesized to have direct effects on brand equity. Further, service leadership is hypothesized to have complementary effects with both customization-personalization control and technology leadership that will increase brand equity.

<sup>6</sup> In our work, brand equity is viewed as different from customer loyalty. Brand equity represents the social bonds between customers and the brand, i.e., the degree of customers' personal identification with the brand or the strength of the social bonds. In contrast, customer loyalty focuses on the consequences of the social bonds, e.g., affective loyalty and conative loyalty. Thus, in our study, brand equity is theorized as the antecedent of customer loyalty.

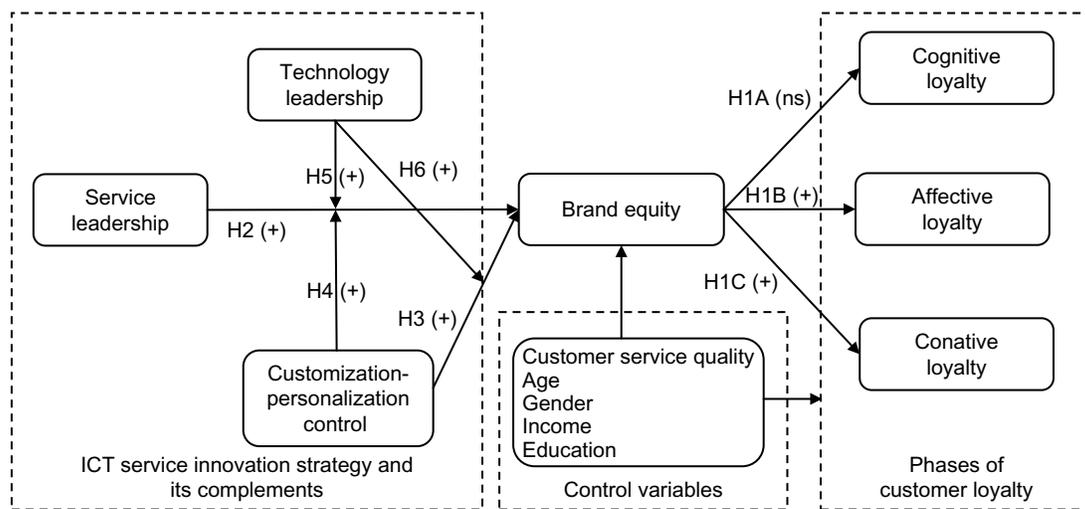
<sup>7</sup> Because cognitive loyalty is based on information about the price and performance of the brand and is operationalized as perceived value, this represents the performance/instrumental values of the product/service that are captured by the ICT innovation and its complementary strategies. Therefore, it is plausible that ICT innovation and its complementary strategies would have direct effects on customer loyalty. As our focus is on opening up the black box to examine the identification mechanism underlying the impacts of these strategies on customer loyalty, we do not propose hypotheses for the direct effects of ICT service innovation strategies on customer loyalty. Nevertheless, we provide the results for these direct effects in the mediated-moderation analysis (Edwards and Lambert 2007) in Online Appendix A (available as supplemental material at <http://dx.doi.org/10.1287/isre.2014.0540>).

#### 3.1. Effect of Brand Equity on Customer Loyalty

As noted earlier, we follow Johnson et al. (2006) and define brand equity as the degree of personal identification with the brand and the brand's relevance to a consumer's situation (Aaker 2004, Keller 1993). This personal identification and relevance with a brand helps to create the differential effect of brand equity on loyalty intentions, which, as we noted earlier, corresponds to conative loyalty, that transcends the instrumental value of a product/service (Johnson et al. 2006, p. 123). In the social psychology literature, people's identities are referred to as "parts of a self composed of the meanings that they attach to the multiple roles they typically play in highly differentiated contemporary societies" (Stryker and Burke 2000, p. 284). Identification is the process of categorizing one's self in relation to other social categories and classifications through which a person's identity is formed (Stets and Burke 2000). Thus, a person's identity is determined by his or her unique combination of roles played in society (Stets and Burke 2000). For instance, a consumer of MDS may play different roles (e.g., sales agent, football fan) in different social situations. Each role is associated with a set of meanings and expectations of behavior, including buying and consuming products/services (Thoits and Virshup 1997). As a sales agent, a consumer may use his or her mobile device to access information about product/service promotions from his or her company's database when meeting with a client. On other occasions, the consumer may watch mobile video clips of the latest football game in his or her role as a football fan. The marketing literature has adapted identity theory to study consumer behavior, such as self-expression (e.g., Aaker 1999). Consumers buy or consume products/services to express the meanings of the roles associated with their identities (e.g., Kleine et al. 1995, Laverie et al. 2002). When products/services of a particular brand reflect a consumer's social roles, the brand becomes part and parcel of the consumer's self-identity and social identity. The outcome of this identification process is the formation of customer-based brand equity (Johnson et al. 2006). The consumer will consider the brand as a part or an extension of himself (herself). This personal identification with the brand leads to individual and social bonds between the consumer and the brand, which can in turn drive customer loyalty (Oliver 1999). As discussed in §2.2.1, we follow the cognition-affect-conation framework of customer loyalty (Oliver 1999) and examine the differential impacts of brand equity on three phases of customer loyalty, i.e., cognitive loyalty, affective loyalty, and conative loyalty.

First, we expect that brand equity will *not* have a significant impact on cognitive loyalty. As discussed

Figure 1 Research Model



earlier, cognitive loyalty is mainly formed based on information about price and performance of a product/service of a particular brand. This represents a consumer's evaluation of the instrumental value of the product/service. We conceptualize cognitive loyalty as perceived service value because this construct incorporates the trade-offs between performance and price, thus capturing the two most important aspects of cognitive loyalty (Oliver 1999). Brand equity as the outcome of the personal identification process is based on the congruence between a consumer's social roles and the brand. This congruence is beyond the superiority of the brand in terms of performance and/or price, i.e., instrumental value. Thus, we expect no direct and significant link between brand equity and cognitive loyalty.

Second, we hypothesize that brand equity will have a positive effect on affective loyalty. Affective loyalty is conceptualized as affective commitment as it reflects the "commitment" notion of the definition of customer loyalty (Oliver 1999). Affective commitment is an emotional factor related to the degree to which a customer identifies and is personally involved with a company and the resulting degree of trust and commitment (Johnson et al. 2006). The consistency between a consumer's self-identity and the product/service he or she purchases or uses can increase the consumer's liking of the brand because a feeling of affinity is developed toward the brand (Del Rio et al. 2001). The marketing literature found that personal and social identification can mitigate the impacts of negative information on brand attitude (Swaminathan et al. 2007). Self-identity expressiveness and identification were found to have positive impacts on consumers' attitude toward purchasing and using products and services (e.g., Madrigal 2001, Thorbjornsen et al. 2007). Thus, we expect brand

equity to have a significant positive effect on affective loyalty.

Finally, a consumer's personal identification with a brand can lead to a stage of self-isolation from information about competitive alternatives and serve to sustain loyalty intentions (Oliver 1999). Because there is little or no cognitive processing of the information about competing brands, consumers will mainly rely on their behavioral intentions when making repurchase or repatronizing decisions and thus stay with the current brand. Indeed, research has found that identification also had a direct impact on behavioral intentions without being mediated by attitude (e.g., Sparks and Shepherd 1992). Thus, we expect that brand equity will have a direct and positive impact on conative loyalty. In sum, we hypothesize the following:

**HYPOTHESIS 1A (H1A).** *Brand equity will not have a significant effect on cognitive loyalty.*

**HYPOTHESIS 1B (H1B).** *Brand equity will have a positive effect on affective loyalty.*

**HYPOTHESIS 1C (H1C).** *Brand equity will have a positive effect on conative loyalty.*

### 3.2. Effect of Service Leadership on Brand Equity

Consumers' perceptions about their ICT service provider's service leadership, i.e., leading in offering new and diversified services in the market, will have a positive effect on brand equity. A consumer's identification with a brand depends on the extent to which the branded services fit the consumer's personal lifestyle and contribute to the self-expression of his or her social roles (Aaker 1999). The marketing literature has shown that the congruity between the self and the brand in either personality or situational traits will generate positive impacts on brand

preference (e.g., Aaker 1999, Jamal and Goode 2001). In our context, consumers use different ICT services to serve or express their different roles. Service innovation will increase the variety of services under the brand and consumers will have a better chance of finding more of their roles, personalities, and lifestyles served by the new services. As consumers' use of the new services increases, the brand will become more integrated into the consumers' personal and social lives, and consumers' identification with the brand, i.e., brand equity, will be enhanced. For example, a leading service provider of 4G MDS can offer new services, such as high-definition TV and video conferencing, that are not available with 3G or 2.5G service providers. A consumer may find that he or she can use a new MDS to follow the results of the latest football matches and watch real-time videos of the goals in his or her role as a football fan. Likewise, using a new video phone call service, the consumer can have a better real-time communication experience with a spouse or friend, thus better fulfilling his or her role as a spouse or friend, respectively. Indeed, when mobile video phone call service was first introduced, the advertisements always focused on the social bonds between the customer and the customer's friends, colleagues, and family. As the new services are offered under the service provider's brand, the service provider's brand equity will be enhanced. Thus, we hypothesize the following:

**HYPOTHESIS 2 (H2).** *Service leadership will have a positive effect on brand equity.*

### 3.3. Effect of Customization-Personalization Control on Brand Equity

We focus on the impact of customization and personalization on personal identification and relevance with a brand and hypothesize that customization-personalization control will have a positive effect on brand equity. As noted earlier, we define customization-personalization control as a consumer's perception of the extent to which the consumer's service provider tailors its offerings—through either customization or personalization—to meet his or her needs. Customized or personalized ICT services can enhance a consumer's identification with the service brand by offering more relevant services that match his or her self-schema (Kleine and Kleine 2000). The marketing literature suggests that a consumer's self-schema is closely related to his or her identities (Kleine and Kleine 2000). The self-schema contains information about oneself including personal values, experiences, and social affiliations (Wyer and Srull 1989). Tam and Ho (2006) found that personalization strategies, such as personal greetings and personalized product offerings, could trigger the self-referent effect on a consumer's information processing and decision

making, and enhance the perceived match between the product offerings and the consumer's self-schema. For example, through a personalized service portal offered under the service provider's brand, a consumer can choose to receive recommendations about MDS that match the consumer's self-schema. The consumer can check the real-time information about inventory in the firm as a sales agent, make instant video phone calls to a spouse, and always get up-to-date news about a favorite football team as a football fan, all of which can serve to fulfill the different roles associated with various identities in the individual's self-schema. When customization-personalization functions are offered under the brand of the service provider, consumers will enjoy greater freedom in choosing the relevant services, such that the match between the services and consumers' identities will be improved and consumers' personal identification with the brand will be enhanced. Thus, we hypothesize the following:

**HYPOTHESIS 3 (H3).** *Customization-personalization control will have a positive effect on brand equity.*

### 3.4. Complementarities Among Strategies

Synergistic gains in performance can be obtained from the complementarities among strategies (Milgrom and Roberts 1990). Milgrom and Roberts (1990) demonstrated the reinforcement effects among complementary strategies that encompassed marketing, technology, and organizational factors. We adapt this notion to propose complementary effects of service leadership, technology leadership, and customization-personalization control on brand equity. In particular, we hypothesize that customization-personalization control can complement service leadership to enhance brand equity. Likewise, technology leadership can facilitate ICT service leadership (i.e., variety of services) and customization-personalization control to increase brand equity.

**3.4.1. Customization-Personalization Control and Service Leadership.** We propose that customization-personalization control reinforces the effect of service leadership on brand equity. In addition to service leadership increasing the variety of services and the potential of the services to help a consumer with more of his or her identities, it increases the information processing cost and learning cost of the new services. Simply increasing the variety of services may even backfire and damage brand equity because consumers will experience information overload (Gourville and Soman 2005). For example, processing the information about each of the over 500,000 iPhone applications is formidable for any consumer. Providing service customization and personalized recommendations will ease the information processing burden faced by consumers and facilitate a better match between

consumer needs and services (Kaplan et al. 2007). More importantly, customization-personalization control can help consumers to realize the potential of the great variety of services to serve/express the various social roles played by them. For example, with customization, a consumer, as a football fan, can freely include mobile news service and mobile video service related to football using the service portal. When a new and relevant mobile service, such as real-time updates of football games, is introduced by the ICT service provider, personalized recommendations can be generated to notify the consumer. These will enhance the match between the brand of the ICT service provider, the consumer's self-schema, and the consumer's identification with the brand, thus increasing brand equity. The potential impact of service leadership on brand equity can be better realized and enhanced when accompanied by greater customization-personalization control. Thus, we hypothesize the following:

**HYPOTHESIS 4 (H4).** *Customization-personalization control will positively moderate the effect of service leadership on brand equity, such that the higher the control, the stronger the effect.*

**3.4.2. Technology Leadership as an Enabler.** Technology leadership, i.e., leading the market by introducing new generations of technologies, will positively moderate the effects of service innovation and customization-personalization control on brand equity. The complementarities between technology leadership and other strategies have been demonstrated by Milgrom and Roberts (1990). In the context of ICT service innovation, technology leadership plays an enabler role to facilitate service leadership (variety of services) and customization-personalization control. Not upgrading the platform technology will cost the firm opportunities to develop new services to satisfy new and emerging customer needs (Meyer and DeTore 2001). Technology leadership can reinforce the impacts of service innovation and customization-personalization control on brand equity by providing new subsystems and interfaces that support greater service variety and customization-personalization possibilities. The synergy between technology leadership and service leadership and between technology leadership and customization-personalization control can be learned by consumers either through the mass media or their own service usage experience. For example, in the MDS market, the technology advancements from phones with keypads to touch-screen smartphones and the evolution of data networks from 2G to 4G have enabled the rapid growth of MDS. Compared to previous generations, 4G networks enable new services, such as multiplayer online gaming and video

conferencing, for consumers to better share their experiences with their friends and better fulfill their social roles. The touch-screen innovation allows consumers to access rich information, e.g., screenshots and peer user evaluation, about services and intuitively customize their service portfolio from lists of top services. Consumers can thus customize or personalize their own service portfolios to best match their roles and identities in a cost-effective way. Thus, we hypothesize the following:

**HYPOTHESIS 5 (H5).** *Technology leadership will positively moderate the effect of service leadership on brand equity, such that the higher the technology leadership, the stronger the effect.*

**HYPOTHESIS 6 (H6).** *Technology leadership will positively moderate the effect of customization-personalization control on brand equity, such that the higher the technology leadership, the stronger the effect.*

## 4. Method

### 4.1. Setting

We tested our model in the context of MDS for the consumer market in Hong Kong. Hong Kong is consistently ranked as a leader in terms of ICT development and sophistication in the world (OFCA 2014). The MDS market in Hong Kong is very competitive, with mobile carriers offering service bundles either with or without subsidized smartphones (OFCA 2014). The MDS providers frequently rely on technology leadership and service leadership to gain a competitive advantage, e.g., one MDS provider was the first mover to introduce 4G MDS in Hong Kong, whereas the other MDS providers reacted with various distinctive strategies (e.g., providing greater service variety). In sum, the highly competitive MDS market in Hong Kong offered an appropriate context for examining the impacts of ICT service innovation and its complementary strategies on brand equity and ultimately, customer loyalty.

### 4.2. Data Collection

We collected data through an online survey with various incentives, such as LCD TVs, as lottery prizes. As the survey was administered in Chinese, the language used predominantly by the residents in Hong Kong, we had the English questionnaire translated by a professional translator to Chinese and then back to English by another translator to ensure translation equivalence (Brislin 1970). Wording differences were discussed and resolved by the translators. The Chinese questionnaire was then pretested on a sample of 150 consumers. Based on the pretest, we found preliminary evidence that the scales were reliable and

valid. Thus, we proceeded with the main data collection. We placed a banner advertisement of the survey on a popular Web portal in Hong Kong. Visitors to the Web portal who clicked on the banner were directed to our web-based survey. The survey was conducted over a period of four weeks. After removing duplicate responses, responses from nonusers of MDS and responses with missing data, we arrived at a final sample of 1,210 consumers (51% women) of MDS, with an average age of 28.9 years and a standard deviation of 8.

### 4.3. Control Variables

We control for the effects of customer service quality on both brand equity and customer loyalty. Customer service quality refers to the overall performance of a firm's customer service function. In our study, this variable serves as the aggregation of the effects of other ICT-based customer services, e.g., responsiveness to service lapses, technical/service help provided, ease of seeking help, and consumer training/education. The marketing literature has demonstrated the salient role of customer service quality in influencing a variety of outcomes including brand equity (e.g., [Berry 2000](#)), perceived value (e.g., [Bolton and Drew 1991](#)), satisfaction ([Cronin et al. 2000](#)), and loyalty intentions (e.g., [Zeithaml et al. 1996](#)). Because customer service quality was found to influence both brand equity (e.g., [Berry 2000](#)) and loyalty intentions (e.g., [Zeithaml et al. 1996](#)), we control for the effects of customer service quality on both brand equity and customer loyalty. We also control for the effects of demographics, i.e., age, gender, income, and education, on both brand equity and customer loyalty.

### 4.4. Measurement Instrument

The appendix shows the various scales used. All items were measured on a seven-point Likert scale. The scales for brand equity and the three phases of customer loyalty were adapted from [Johnson et al. \(2006\)](#). [Oliver \(1999\)](#) conceptualized cognitive loyalty as based on information about performance and price of a product/service of a particular brand. We used perceived value as the operationalization of cognitive loyalty because this construct incorporates the trade-offs between performance and price, thus capturing the two key aspects of the information base for cognitive loyalty ([Oliver 1999](#)). Affective loyalty was operationalized as affective commitment, as it reflects the "commitment" notion of the definition of customer loyalty ([Oliver 1999](#)). The loyalty intention scale by [Johnson et al. \(2006\)](#) was used to measure conative loyalty ([Evanschitzky and Wunderlich 2006](#)). This scale included both word-of-mouth elements (i.e., brand recommendation) and repurchase/continuance intention ([Zeithaml et al. 1996](#)). The scale for brand

equity captured consumers' identification with the focal brand. The scale for customer service quality was adapted from [Yoo et al. \(2000\)](#). Age was measured in years. Income was measured with consumers reporting their monthly income in thousands of Hong Kong dollars. Education was measured on a four-point scale—(1) elementary school; (2) middle and high school; (3) undergraduate degree or equivalent; and (4) graduate degree or above. Gender was coded as 1 for men and 0 for women.

We developed new items for technology leadership, service leadership, and customization-personalization control. The scale for technology leadership measured how a consumer perceived the frequency and the timing of the introduction of platform technology innovations to the market by his or her current ICT service provider. The scale for service leadership focused on a consumer's perception of the speed and timing of his or her current service provider in introducing new services and being a market leader in the variety of services in the market. The scale for customization-personalization control measured the extent to which ICT services offered by the current service provider can be customized and/or personalized to meet a consumer's needs. Taking into account the different initiating party between customization and personalization, we measured this construct using a unidimensional formative scale (see [Petter et al. 2007](#)).<sup>8</sup>

We also examined the issues of nonresponse bias and common method bias (CMB) in the data. Following [Armstrong and Overton \(1977\)](#), we assessed nonresponse bias by comparing early respondents with late respondents in terms of their profiles. There were no significant differences in gender ( $p > 0.05$ ) and age ( $p > 0.05$ ) between the first-week respondents and the fourth-week respondents. We first checked for CMB using Harman's single-factor test ([Podsakoff et al. 2003](#)). No general factor was found in the unrotated factor matrix, alleviating concerns regarding CMB. Next, we applied the CFA marker technique to further test for CMB ([Lindell and Whitney 2001](#)). This technique was also recommended by [Malhotra et al. \(2006\)](#). We followed the approach of [Malhotra et al. \(2006\)](#) for the post-hoc estimation of CMB and chose the second-smallest positive correlation ( $r = 0.05$ ) between two items (BE5 and TL4) as a more conservative estimate. After deducting this value from all of the correlations, we reran our analysis with the new correlation matrix as the input. The results showed no significant differences between the

<sup>8</sup> We also specified a second-order factor model for this construct with customization and personalization as two formative dimensions. We found no significant difference in the results between the two measurement models and thus adopted a unidimensional scale.

**Table 1** Reliabilities, Descriptive Statistics, and Correlations

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	28.90	8.00	—											
2. Gender	0.49	0.51	0.04	—										
3. Income (monthly)	16,444	12,180	0.15*	0.17**	—									
4. Education	2.54	1.12	0.13*	0.13*	0.16**	—								
5. Customer service quality	5.11	1.59	0.13*	-0.14*	0.05	0.04	0.75							
6. Service leadership	4.30	1.77	-0.07	-0.13*	0.05	0.03	0.29***	0.73						
7. Customization-personalization control	4.28	1.61	0.04	0.05	0.06	0.08	0.28***	0.24***	—					
8. Technology leadership	5.01	1.49	-0.10	0.12	0.02	0.04	0.28***	0.40***	0.25***	0.75				
9. Brand equity	4.80	1.64	0.13*	-0.14*	0.05	0.07	0.35***	0.34***	0.30***	0.13*	0.77			
10. Cognitive loyalty	5.10	1.22	0.08	0.16**	0.04	0.13*	0.35***	0.28***	0.37***	0.23***	0.30***	0.70		
11. Affective loyalty	4.35	1.03	0.17**	-0.13*	0.03	0.05	0.39***	0.30***	0.33***	0.33***	0.26***	0.40***	0.73	
12. Conative loyalty	4.13	1.50	0.13*	0.05	0.07	0.04	0.16***	0.17**	0.15**	0.17**	0.35**	0.28***	0.22***	0.74

Notes.  $n = 1,210$ ; numbers on the diagonal are Cronbach alphas and off-diagonal entries are correlations.  
 $*p < 0.05$ ;  $**p < 0.01$ ;  $***p < 0.001$ .

original path coefficients and the reestimated coefficients, thus indicating that CMB was less of a concern in our study.

#### 4.5. Hypotheses Testing

We used hierarchical regression analysis to test our model. All measures were mean centered to reduce multicollinearity before computing the product terms (Aiken and West 1991). Hierarchical estimation was performed when predicting brand equity. First, we entered only the control variables, i.e., customer service quality, age, gender, income, and education. Second, we estimated the main-effects model without the interaction terms. Finally, the interaction terms were entered into the model. Further, we performed a *post-hoc* analysis for two reasons: (1) to establish the robustness of the mediation of brand equity of the hypothesized moderation effects on customer loyalty, we conducted a mediated moderation analysis (Edwards and Lambert 2007; see Online Appendix A for details); and (2) to address potential endogeneity between brand equity and the three phases of customer loyalty, we used Heckman’s approach in conjunction with OLS (ordinary least squares) (Heckman 1979).

### 5. Results

We first examined reliabilities, descriptive statistics, and correlations—these results are shown in Table 1. All Cronbach alphas were above the acceptable threshold of 0.70 (Nunnally 1978), thus supporting reliability. Additionally, a factor analysis with direct oblimin rotation to allow for correlated factors supported convergent and discriminant validity—these results are shown in Online Appendix B. The correlations were mostly in the direction expected, thus lending preliminary support to some of the main effects hypotheses.

The results of our model tests are shown in Table 2. Overall, the empirical tests supported most of our hypotheses. Our full model explained 30% of the variance in brand equity. The main effects hypotheses, i.e., H2 and H3, were supported. Two of the three hypothesized moderation effects, i.e., H4 and H5, were supported. Therefore, our hypotheses about strategy complementarity were partially supported. The  $f^2$  was above 0.15 for the two-way interactions, indicating a medium-level effect size (Cohen 1988).

#### 5.1. Main Effects

As shown in Table 2 (see column 2a under affective loyalty and conative loyalty, respectively), brand equity was significant in predicting affective loyalty (i.e.,  $\beta = 0.24$ ,  $p < 0.001$ ) and conative loyalty ( $\beta = 0.28$ ,  $p < 0.001$ ). Thus, the greater the extent of personal identification and relevance a consumer attaches to his or her current service provider’s brand, the higher the consumer’s affective loyalty and conative loyalty. The effect of brand equity on cognitive loyalty was nonsignificant ( $\beta = 0.08$ ,  $p > 0.10$ ; see column 2a under cognitive loyalty).<sup>9</sup> Thus, H1A through H1C were supported. Service leadership was a significant determinant of brand equity ( $\beta = 0.25$ ,  $p < 0.001$ ; column 2 under brand equity), thus supporting H2. Likewise, customization-personalization control had a significant impact on brand equity ( $\beta = 0.20$ ,  $p < 0.001$ ), thus supporting H3. Both service leadership and the provision of customization-personalization control had significant effects on brand equity. The effects were significant even after we controlled for the effects of consumer demographics and customer service quality that represented the

<sup>9</sup>Given the support for the null hypothesis, the issue of power is important. Because of the large sample size, we found that we could have detected even small effects.

**Table 2** Results of Model Testing: Predicting Brand Equity and Customer Loyalty

Independent variables	Brand equity			Cognitive loyalty				Affective loyalty				Conative loyalty				Hypothesis supported	
	1	2	3	1	2a	2b	3	1	2a	2b	3	1	2a	2b	3		
Control variables																	
Age	0.10	0.05	0.02	0.05	0.04	0.03	0.03	0.17**	0.15*	0.10	0.05	0.12*	0.10	0.08	0.05		
Gender	-0.05	-0.04	-0.03	0.13*	0.12*	0.10	0.08	0.10	-0.08	-0.07	-0.06	0.04	0.03	0.03	0.02		
Income	0.02	0.01	0.01	0.03	0.02	0.02	0.01	0.03	0.02	0.02	0.01	0.04	0.02	0.01	0.01		
Education	0.01	0.00	0.00	0.04	0.02	0.01	0.01	0.04	0.03	0.02	0.01	0.04	0.03	0.02	0.01		
Customer service quality	0.26***	0.20***	0.12*	0.17**	0.15*	0.12*	0.03	0.14*	0.12*	0.10	0.06	0.15*	0.14*	0.13*	0.12*		
Brand equity	N/A			0.08			0.07	0.24***			0.15*	0.28***		0.14*	H1A–1C: Yes		
ICT service innovation and complementary strategies																	
Service leadership (SL)	0.25***			0.14**		0.13*	0.04	0.15*			0.12*	0.13*		0.06	H2: Yes		
Customization-personalization control (CP)	0.20***			0.12*		0.14*	0.12*	0.16*			0.10	0.13*		0.05	H3: Yes		
Technology leadership (TL)	0.06			0.04		0.17**	0.13*	0.04			0.06	0.10		0.08			
Strategic complements																	
SL × CP	0.24***															H4: Yes	
SL × TL	0.19**															H5: Yes	
CP × TL	0.05															H6: No	
R <sup>2</sup>	0.14	0.22	0.30	0.06	0.06	0.20	0.20	0.07	0.13	0.17	0.20	0.05	0.15	0.13	0.15		
ΔR <sup>2</sup>	0.08**			0.08**		0.00	0.14***	0.00	0.06**			0.10**	0.03*	0.10**	0.08**	0.02*	

Notes.  $n = 1,210$ ;  $\Delta R^2$  shows the additional variance of models 2, 2a, and 2b over model 1; further, the  $\Delta R^2$  for model 3 is the additional variance over models 2 and 2b.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

impacts of other factors related to ICT service innovation, such as after-sale services supported by ICT. We also found that technology leadership and customization-personalization control had significant direct effects on cognitive loyalty (TL:  $\beta = 0.13$ ,  $p < 0.05$ ; CP:  $\beta = 0.12$ ,  $p < 0.05$ ; see column 3 under cognitive loyalty)<sup>10</sup> and service leadership had a significant direct impact on affective loyalty ( $\beta = 0.12$ ,  $p < 0.05$ ; see column 3 under affective loyalty).

## 5.2. Interaction Effects on Brand Equity

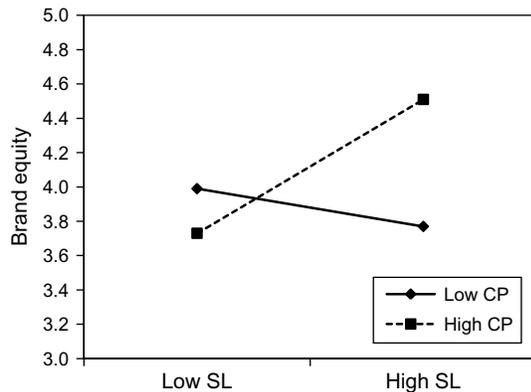
The interaction effects between service leadership and customization-personalization control and between service leadership and technology leadership were significant, thus supporting H4 and H5. Therefore, the effect of service leadership on brand equity, i.e., the potential of service innovation to better serve a consumer's multiple roles and express his or her personal identities so as to enhance the consumer's identification with the brand, can be better realized when greater customization-personalization control is provided to match the various services with the consumer's personal and social identities (SL × CP:  $\beta = 0.24$ ,  $p < 0.001$ ). Similarly, technology leadership plays an enabler role to support service innovation to a greater extent that in turn enhances the relevance

of the overall service portfolio to a consumer's identities and roles (SL × TL:  $\beta = 0.19$ ,  $p < 0.01$ ). However, the interaction between technology leadership and customization-personalization control was not significant when predicting brand equity (TL × CP:  $\beta = 0.05$ ,  $p > 0.10$ ).

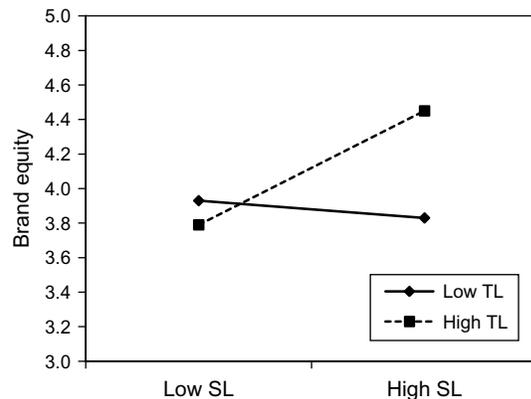
We plotted the two interaction effects in order to better understand them (Aiken and West 1991). Figures 2(a) and 2(b) show the plots of the significant interactions between service leadership and customization-personalization control and between service leadership and technology leadership, respectively. The graphs were plotted at one standard deviation above and below the mean. For consumers who had high customization-personalization control, service leadership was positively related to brand equity ( $\beta = 0.35$ ,  $p < 0.001$ ). For individuals who had low customization-personalization control, service leadership was negatively related to brand equity ( $\beta = -0.10$ ,  $p < 0.05$ ; see Figure 2(a)), thus indicating an information overload effect or backfire effect on brand equity when there was too much service variety (Gourville and Soman 2005). For consumers who perceived technology leadership to be high, service leadership was positively related to brand equity ( $\beta = 0.33$ ,  $p < 0.001$ ). However, for consumers who perceived technology leadership to be low, there was no significant relationship between service leadership and brand equity ( $\beta = -0.05$ ,  $p > 0.05$ ; see Figure 2(b)). These results demonstrated the significance of the two interaction effects on brand equity

<sup>10</sup> Thus, the results supported the rationale that, as cognitive loyalty is based on information about the price and performance of the brand (operationalized as perceived value), both technology leadership and customization-personalization control have direct relationships with this phase of customer loyalty.

**Figure 2(a)** Interaction Between Service Leadership and Customization-Personalization Control



**Figure 2(b)** Interaction Between Service Leadership and Technology Leadership



*Note.* TL, technology leadership; SL, service leadership; CP, customization-personalization control.

hypothesized in H4 and H5. The two interaction effects explained 8% additional variance in brand equity.

In the context of MDS, only the synergies between service leadership and customization-personalization control and between service leadership and technology leadership generated significant impacts on brand equity. These results indicate that consumers did not associate technology innovation with customization-personalization control when they evaluate the brand equity. We conjecture that this nonsignificance is due to the fact that customization and personalization are mainly provided by ICT service providers via their service portal without emphasizing the link between technology advancement and better customization-personalization control. Thus, in consumers' brand knowledge, the association and the complementarity between technology leadership and customization-personalization control is not as

strong as the other two combinations of complementary strategies.

### 5.3. Post-Hoc Analysis

We conducted mediated moderation analysis to establish the robustness of the mediation of brand equity of the hypothesized interaction effects on customer loyalty (Edwards and Lambert 2007). The results showed that the conditions for mediated moderation were met for the two complementarity effects between service leadership and customization-personalization control, and between service leadership and technology leadership. Online Appendix A provides the details of the equations, tests, and results—here, we discuss the findings. Overall, the mediated moderation analysis supported our theory that brand equity mediates the moderating effects of customization-personalization control and technology leadership on the effects of service leadership on affective loyalty and conative loyalty, respectively. In particular, the indirect effects of service leadership on affective loyalty and conative loyalty at a high level of customization-personalization control are significantly higher than those at a low level, indicating that brand equity mediates the moderating effects of customization-personalization control on the effects of service leadership on affective loyalty and conative loyalty. Similarly, we found support for brand equity mediating the moderating effects of technology leadership on the effects of service leadership on affective loyalty and conative loyalty. Also, the indirect effects of service leadership on affective loyalty and conative loyalty at a high level of technology leadership are significantly higher than those at a low level, indicating that brand equity mediates the moderating effects of technology leadership on the effects of service leadership on affective loyalty and conative loyalty. These findings are consistent with the results shown in Table 2, where the interactions between service leadership and customization-personalization control and between service leadership and technology leadership influence brand equity (supporting H4 and H5) that in turn predicts affective loyalty and conative loyalty (supporting H1B and H1C). We found no support for brand equity mediating any interaction effect between the ICT service innovation strategy and its two complementary strategies on cognitive loyalty, which is consistent with the results in Table 2 that brand equity had no significant effect on cognitive loyalty (supporting H1A). Finally, we did not find support for brand equity mediating the effect of the interaction between technology leadership and customization-personalization control on any phase of customer loyalty, consistent with the finding that there is no significant moderating effect of the technology leadership on the impact of customization-personalization control on brand equity.

To address potential endogeneity in our model, we conducted Heckman's (1979) two-stage approach with OLS. Our model posits that brand equity affects customer loyalty, although there are arguments and evidence that customer loyalty may influence brand equity (e.g., Yoo et al. 2000). Although in such cases, theory is the most important guide, consistent with other research (e.g., Shaver 1998) including recent IS research (e.g., Hsieh et al. 2011), we used Heckman's (1979) two-stage approach to evaluate the potential effects between the phases of customer loyalty and brand equity. The results from the second stage confirmed that although the inverse Mills ratio was significant, our original estimates were robust with only a slight change in the magnitude and no change in the significance of coefficients, thus suggesting that an endogeneity issue is not a significant concern in our study.

## 6. Discussion

We examined the impacts of ICT service innovation and its complementary strategies on the cognition-affect-conation phases of customer loyalty through customer-based brand equity. Our study provided support for most of the hypotheses in our model. In this section, we discuss the theoretical and managerial implications of our findings for service management (Rai and Sambamurthy 2006) and service science (Chesbrough and Spohrer 2006), with a particular focus on the strategic management of an ICT service provider's brand.

### 6.1. Theoretical Implications

First, we have identified the importance of brand equity and customer loyalty to research on ICT service management. Johnson et al. (2006) examined marketing variables as determinants of brand equity and customer loyalty—we extend their model by integrating the synergistic impacts of the three constructs that represent service innovation and its complementary strategies on brand equity that in turn affect the three different phases of customer loyalty. Our findings suggest that brand equity formed from ICT service innovation can attract consumers to the service provider and cause consumers not to use cognitive judgment when making repurchase decisions or engage in information search behaviors. Moreover, the differential impacts of brand equity on different phases of customer loyalty suggest that ICT service innovation has profound business value for ICT service providers. Our research suggests that as ICT services become integrated into every aspect of consumers' personal and social lives, their function of serving consumers' social roles and identities can exert impacts on customer loyalty phases that transcend the instrumental values of the services,

i.e., affective loyalty and conative loyalty (Johnson et al. 2006, Oliver 1999). Our study contributes to the IS literature by theorizing about and testing brand equity as the mechanism underlying the impacts of ICT service innovation strategies on different phases of customer loyalty.

Second, our research suggests an interdependent view of ICT strategies, particularly when studying the effects of ICT service innovation on consumers' decision making. We extend prior IS research that has examined ICT innovation strategies separately by studying the synergy between the ICT service innovation strategy and its two complementary strategies. In particular, service leadership, customization-personalization control, and technology leadership are theorized to complement each other to influence brand equity. By recommending and/or having a consumer choose the right services for self-expression or fulfilling his or her various social roles, customization-personalization control enhances the match between the consumers' social identities and the ever-growing service portfolio enabled by service leadership, i.e., enhanced impact of service leadership on brand equity. Next, technology innovations, i.e., technology leadership, complement the service leadership strategy by serving as another enabler that increases the variety of services, thus increasing the potential for the overall service portfolio to serve more social roles of the consumer. In addition, technology innovations may enhance customization-personalization mechanisms by supporting superior and more appropriate user interfaces and more intelligent recommendation agents. We theorized these mutually beneficial effects among the strategies in our model and found support for the first two combinations of strategies in the context of the MDS market.

Finally, our research examines the role of technology evolution in influencing ICT service providers' strategic choices and the consequent business outcomes, i.e., brand equity and customer loyalty. From a technology perspective, the evolution of ICT involves the advancement of both the platforms, i.e., devices and networks, and the service portfolios that they enabled. From a social perspective, the evolution of platforms and their associated service portfolios has profound impacts on consumers' personal and social lives that affect ICT service providers' choice of service innovation strategies. In our study, the evolution of mobile technology enables the diffusion of MDS into consumers' daily lives, serving their self-identities and social identities. The combination of service leadership (i.e., leading in service variety), technology leadership (i.e., providing the latest platforms), and customization-personalization control mechanisms adopted by ICT service providers can influence the degree of the technology diffusion in

society and the degree of consumers' identification with their brands, i.e., brand equity, that in turn affects customer loyalty. As noted by Orlikowski and Iacono (2001, p. 131), one of the five premises for theorizing about IT artifacts is that "...artifacts undergo various transitions over time...while coexisting and coevolving with multiple generations of the same or new technologies at various points in time." Our research thus contributes to the IS literature by studying how ICT service innovation under rapid technology evolution influences business-related outcomes of ICT service providers. Future research can follow this line of inquiry to provide more insights into this issue. For instance, technology evolution can be either radical or incremental (see Xu et al. 2010), which may then have different implications for the combination of ICT service innovation and its complementary strategies adopted by ICT service providers and its impact on business outcomes.

## 6.2. Managerial Implications

First, our study directs ICT service providers' attention to managing the brand of their services under rapid technology evolution and intense competition. Although maintaining/improving brand equity and customer loyalty is always an important strategic issue for every organization (Keller and Lehmann 2006), ICT service providers face the particular challenge of managing their brands when technology advancement always disrupts the landscape of competition by significantly changing what ICT service providers can offer to their customers (Lyytinen and Rose 2003). This disruption in turn undermines the base of loyal customers of ICT service providers and results in frequent switching behavior. In such a dynamic and competitive market, achieving higher brand equity, i.e., stronger individual and social bonds between the consumers and the brand, will be a major competitive advantage for ICT service providers. We found that customer-based brand equity was an important determinant of affective loyalty and conative loyalty. Thus, our research suggests that ICT service providers should pay attention to the impacts of technology evolution on their brands and utilize the power of their brands to gain a competitive advantage, such as maintaining customer loyalty.

Second, ICT service providers need to provide superior customization-personalization functions for their customers to find a better match between the services and their social roles and identities, so as to facilitate the identification process leading to higher brand equity. Consumers use ICT services not only to meet their instrumental needs, such as improving the efficiency of their lives/jobs but also to serve

and express their social roles and identities, e.g., a working professional, a parent, and a football fan. Our study showed the importance of introducing new services and increasing the variety of services to serve consumers' social roles and identities. Moreover, we found that in order to avoid the information overload caused by the increasing variety of services and provide a more effective and efficient matching between the services and consumers' roles and identities, customization-personalization functionalities are needed to reinforce the power of service innovation. For instance, in the case of the iPhone, consumers can freely browse and select applications from Apple's App Store and the Genius function provides personalized recommendations to consumers that collectively enhance consumers' attachment to Apple's brand. Thus, a combination of service innovation and customization-personalization control can be an effective way to build brand equity and customer loyalty.

Finally, our results confirmed the strategic value of technology leadership in complementing service innovation. ICT service providers need to coordinate resources on technology innovation to achieve optimal business outcomes from service innovation. Technology innovation enables a greater variety of services and more possibilities for customization and personalization. For instance, when MDS first appeared on the market, NTT DoCoMo took the lead in technology innovation by offering its own device models customized for MDS and providing its own service portal for consumers. It also introduced the cHTML language for third-party application developers to develop new services on the mobile Internet for consumers. Device manufacturers gradually took over the role of the service provider by following Apple's business model for the iPhone. Apple, for example, can be regarded as a new leader in the MDS market because (1) it keeps rolling out new generations of iPhone devices—3G, 3GS, 4, 4S, 5, 5S, and 6; (2) it provides a service portal, the App Store, with an ever increasing number of applications/services; and (3) it provides an application development environment—the iOS SDK for third-party application developers. Both NTT DoCoMo and Apple have enjoyed a competitive advantage derived from their brands through their technology leadership. The two cases further support our findings that technology leadership can complement service innovation to increase brand equity and ultimately, customer loyalty. Thus, a combination of service and technology innovation can achieve improved business performance through increased customer loyalty. ICT service providers should carefully evaluate the trajectory of technology

evolution and make forward-looking plans for technology innovation.

### 6.3. Limitations and Future Research

Our study has some limitations that should be noted. First, we did not include the fourth phase of customer loyalty, i.e., action loyalty (Oliver 1999), in our model. Although the first three phases complete the cognition-affect-conation framework (Oliver 1980) and conative loyalty (i.e., intention) is directly associated with action loyalty (i.e., behavior), the components of behavior control and action inertia implied by action loyalty were not captured in our model. Future research can collect data about customer loyalty based on objective behavioral measures, such as archival data about customer retention/switching and habitual behavior. Second, our study focused on one particular type of ICT service, i.e., MDS, in a particular region (Hong Kong), that has a highly developed ICT service market. Future research can examine our model in other contexts involving different types of ICT services and/or from different regions/countries, so as to assess the generalizability of our findings. Third, we collected data using an online survey. Future research can use a random sampling approach to improve the representativeness of the sample. Fourth, we chose a unidimensional measure for brand equity and focused on the outcome or degree of personal identification. There are other general conceptualizations (e.g., Aaker 1996, Keller 1993) and measurement (e.g., Yoo et al. 2000) of brand equity. Future research may examine the relationship between ICT service innovation and brand equity with different conceptualization and measurements of brand equity. Also, future research can include more constructs that characterize the identification process in the model to better understand the mechanisms underlying the effects uncovered in this work. Finally, we focused on ICT service innovation and its complementary strategies. Future research can examine other factors related to ICT service innovation,

e.g., viral marketing, competitive actions of rivals, and member-gets-member strategy, to provide a more comprehensive study of the interactions among different ICT strategies.

## 7. Conclusions

We have studied the impacts of ICT service innovation, i.e., service leadership, and its complementary strategies, i.e., customization-personalization control and technology leadership, on customer loyalty. We found that both service leadership and customization-personalization control had significant direct effects on ICT service providers' brand equity that in turn influenced customers' affective loyalty and conative loyalty. Also, when the level of technology leadership or customization-personalization control was high, the impact of service leadership on brand equity was enhanced. This study contributes to research on service management and service science in general, and ICT service innovation management in particular, by highlighting the mediating role of brand equity on the impacts of ICT service innovation and its complementary strategies on customer loyalty. Future research can build on our model to investigate other strategic/managerial issues related to ICT service innovation.

### Supplemental Material

Supplemental material to this paper is available at <http://dx.doi.org/10.1287/isre.2014.0540>.

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## Appendix. Measurement Scales

Constructs	Items
Brand equity	BE1. The brand of my MDS provider reflects my personal lifestyle. BE2. My MDS provider's brand fits well with my personality. BE3. I can identify with my MDS provider's brand. BE4. If my MDS provider were a person, I would like to take him or her out for dinner. BE5. I would like to wear clothing with the logo of my MDS provider's brand on it.
Technology leadership	My MDS provider: TL1. ... keeps rolling out state-of-the-art technologies. TL2. ... frequently introduces technological innovations for its customers. TL3. ... is always among the first that introduce the latest generation of technology. TL4. ... always deploys innovative technologies to the market before others.

**Appendix. (Continued)**

Constructs	Items
Service leadership	My MDS provider: SL1. ... keeps introducing new services to the market. SL2. ... frequently innovates its service offerings for its customers. SL3. ... offers a great variety of services. SL4. ... always provides a diversified selection of services for its customers.
Customization-personalization control <sup>1</sup>	My MDS provider: CP1. ... allows me to freely choose the mobile services I want. CP2. ... gives me control over customizing mobile services in the way I want. CP3. My MDS provider recommends services that fit my specific needs. CP4. The services provided by my MDS provider have features personalized for me. CP5. My MDS provider knows what I want.
Customer service quality	SQ1. My MDS provider's customer services are of high quality. SQ2. My MDS provider's customer services are always functional. SQ3. The performance of my MDS provider's customer services is very reliable. SQ4. My MDS provider's customer services are of high performance. SQ5. My MDS provider's customer services appear to be of poor quality. (reverse-coded)
Cognitive loyalty	CogL1. My MDS provider's services have a good level of performance for the money I pay. CogL2. The service package I got from my MDS provider is a good deal relative to other offers available in the market. CogL3. The price of my MDS provider's services is more than fair for the performance I receive. CogL4. The service package I got from my MDS provider is a great value.
Affective loyalty	AL1. I take pleasure in being a customer of my current MDS provider. AL2. My MDS provider takes the best care of its customers. AL3. There is presence of reciprocity in my relationship with my MDS provider. AL4. I have feelings of trust toward my MDS provider.
Conative loyalty	ConL1. I encourage friends and relatives to be the customers of my MDS provider. ConL2. I say positive things about my MDS provider to other people. ConL3. I will use more services offered by my MDS provider in the next few years. ConL4. I would recommend my MDS provider to someone who seeks my advice. ConL5. I consider my MDS provider to be my first choice.

<sup>1</sup>Customization-personalization control was specified as a unidimensional formative scale.

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