

Network effects and intrinsic attributes of mobile services: Mapping perceived service values on business model choices

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Abstract

This paper applies and further develops a research model of the relationships between business model dimensions, intrinsic and extrinsic attributes of mobile services, and their perceived end-user values (Pedersen and Methlie, 2004). The model suggests a set of hypotheses on the effects of service providers' choice of revenue model, governance form and service strategy on direct network effects, indirect network effects and intrinsic attributes of mobile services. Here, we investigate how these relationships are reflected in the minds of mobile service provider professionals. Thus, we raise the question if business model choices made by professionals in the mobile service provider markets reflect considerations of direct and indirect network effects of mobile services.

A focused survey of 54 professionals in mobile service provider companies was conducted. To reflect differences in the importance of extrinsic and intrinsic service attributes, six mobile services were selected, and professionals responsible for each of these services were sampled. The survey reveals that the service provider professionals find the six services to reflect our hypothesized differences in service attributes. Hypotheses that revenue model, governance form and service strategy, should be designed specifically to facilitate these differences in service attributes, however, were not consistently supported. The findings reveal that providers of mobile services have underdeveloped perceptions on how business models facilitate the extrinsic and intrinsic service attributes giving increased end-user values of mobile services. Implications for the mobile data services industry as well as for further research are discussed.

Keywords: Business models, service attributes, perceptions, customer value.

1. Introduction

Recent analyst reports suggest that open, collaborative business models are required to obtain variety in service offerings and, consequently, adoption of service platforms as well as end-user services. The authors most often refer to the Nordic experience with the so called CPA-models (Content Provider Access) for SMS and MMS services (Strand Consult, 2002, Northstream, 2002). This open model, however, has not been equally successful in providing WAP services in these countries. On the other hand, closed, vertically integrated business models have been successful when more advanced mobile data services have been introduced in other countries, as for instance, the semi-walled garden model of DoCoMo's I-mode services in Japan and the model applied by Vodafone to provide their "Live!" services. Thus, both successful and less successful business models can be found whether they are closed or open, and more knowledge is required on how business model choices affect service attributes and ultimately, customer value.

The purpose of this paper is to extend research on the conceptual dimensions of mobile services business models into explorations of the relationship between business model choices and business performance. In this paper, performance is discussed in the context of

the perceived and anticipated value of the services offered. In the next section, we review some of the literature and recent empirical studies on mobile services business models, mobile services attributes and end-user adoption. In section 3, a model of the relationship between these elements is presented, and a set of hypotheses is put forward. The hypotheses are tested in an empirical study of 54 service provider professional's perceptions of the relationship between business model choices and service attributes for six different services. The results are reported in section 5, and implications for industry and research are discussed in section 6.

2. Theory

Explanations of mobile data services success span from focusing specific factors, such as the lack of an appropriate revenue model (Bohlin, Bjorkdahl and Lindmark, 2003) to suggesting general systemic explanations (Vesa, 2003). The most common approach, however, is to combine a set of technological, business strategic and behavioral or cultural factors (Henten et al., 2003, Pedersen, 2001). Our focus is on the causal relationship between business model options and end-users' behavioral factors.

The term *business model* has been used mostly in traditional electronic commerce to describe the key components of a business (Timmers, 1998, Weill & Vitale, 2001). Methlie and Pedersen (2002) included three operational dimensions in their business model concept: integration model, collaboration model, and revenue model. Recently, several authors have applied the business model concept to mobile commerce and mobile data services contexts (Campanovo and Pigneur, 2003; Faber et al., 2003, Bouwman, 2003). With some variations in the concepts applied, these authors suggest four dimensions of business models: the product innovation, the customer relationship, the infrastructure and the financial dimensions, covering the product related value proposition, the customer related value proposition, the structural dimension and the revenue dimension, respectively (e.g. Campanovo and Pigneur, 2003). However, the choice between specific options along these dimensions and the performance effects of choosing specific options under different structural conditions have been given less attention in this literature. However, it is well documented that the choice of specific business model options affects the intrinsic and extrinsic attributes of the product developed or produced, and this further affects performance (Nicholls-Nixon and Woo, 2003; Zahra and Nielsen, 2002; Sengupta, 1998; Stuart, 2000).

Service attributes emerge from two different sources. *Intrinsic attributes* refer to the inherent attributes of the service itself, whereas *extrinsic attributes* emerge from the networks that provide and use network services. This involves an extension of the traditional typology of intrinsic and extrinsic sources of value suggested by Holbrook (1996), and underlines how network services are different from traditional products and services where extrinsic attributes often originate from supplier services and consumer investments (Mathwick, Malhotra and Rigdon, 2001). The two types of attributes represent the sources of intrinsic and extrinsic value unique to network services (Lee and O'Connor, 2003).

Many unique intrinsic attributes characterizing mobile services have been mentioned. One of the most obvious characteristics of mobile services is the lack of constraints related to time and space (Balasubramanian, Peterson and Jarvenpaa, 2002, Watson, et al., 2002). Others suggests that "being personal" is an additional intrinsic attribute of mobile data services Doyle, 2001, Kannan, Mei Chang and Whinston, 2001). Even though the lack of constraints related to time and space of mobile services has been suggested as the basis for their *usefulness* (Pedersen and Nysveen, 2003), usefulness is mainly determined by the content of the service – its functionality. Another unique intrinsic attribute, *enjoyment*, was found important in four studies of mobile service adoption by Nysveen, Pedersen and

Thorbjørnsen (2005). Intrinsic attributes of a service may also be described by technical specifications, for example related to speed and capacity. Nordman and Liljander (2003) suggest that dial-up speed and configuration settings are important for mobile *service quality*, another important intrinsic attribute.

The two most often mentioned extrinsic attributes of network goods are direct and indirect network effects. Direct network effects are the effects related to increasing value of a service as the *size of the network* increases (Liebowitz and Margolis, 1999). While direct network effects are important extrinsic attributes of communication services, indirect network effects are more often focused in information, transaction or machine-interactive services. Indirect network effects originate from direct network effects when the networked good is a platform for complementary services and products (Gupta, Jain and Sawhney, 1999). Some generic mobile data services like SMS and MMS offer a platform for other, complementary services. For information and machine-interactive services, like premium SMS, mobile Internet access or game services, the potential for generating indirect network effects is great. From the concept of indirect network effects, a set of operational extrinsic service attributes, such as complementary service *variety*, *speed* of complementary service development, and complementary *service quality* may be identified. As for direct network effects, considerable attention has been given to the importance of indirect network effects in explaining consumers' willingness to pay for network goods. For example, researchers in economics, marketing and information systems have concluded that the availability of complementary goods affects the prices that can be obtained for network goods (Gandal, Kende and Rob, 2000; Basu, Mazumdar and Raj, 2003; Brynjolfsson and Kemerer, 1996).

Recently, end-users' *perceptions* of network effects have also been given considerable attention. Studies of innovations show that adoption likelihood is sensitive to critical mass and anticipation of future network size (Shapiro and Varian, 1999, Lee and O'Connor, 2003; Montaguti, Kuester and Robertson, 2002). Perceptions and anticipation of direct network effects have also recently achieved considerable attention in information systems, strategy and marketing literature (Gallaughner and Wang, 2002; Schilling, 2003; Frels, Shirvane and Srivastava, 2003). Most of these studies have been conducted in professional end-user markets, suggesting that direct network effects are taken into consideration in professional end-users' value assessments. In consumer markets, end-users' appreciation of complementary service variety and network size may vary across user segments. For professional consumers, complementary service variety is assessed and appreciated (Frels et al., 2003, Schilling, 2003). However, for complex or radically new network goods like mobile data services, the assessment and valuation of indirect network effects are much more difficult.

Network effects are typical of all communication and person-interactive mobile services and have also been used as a basis for understanding value propositions and the choice of governance forms in telecommunication networks. In their study of 125 value added services, Brosseau and Quelin (1996) found that telecommunication communication services and information services were controlled by applying systematically different governance forms.

From this selective and brief review of some of the recent research on business models, service attributes and service adoption in mobile services markets, we suggest that the relationships between these elements may be explained by a model where options along specific business model dimensions are operational, relevant intrinsic and extrinsic service attributes are specified, and knowledge of end-users' perceptions of service attributes are moderated.

3. Model and hypotheses

Adoption of mobile data services can be studied by using the theory of two-sided markets as the organizing framework. A two-sided market is characterized by the presence of two distinct sides whose ultimate benefit stems from interacting through a common platform (Rochet and Tirole, 2003). Most markets with network effects are two-sided. We aim to simultaneously study the interaction between service providers and end-users of such markets. However, in this paper, our focus is on the service provider side of the model. Our research model is shown in figure 1.

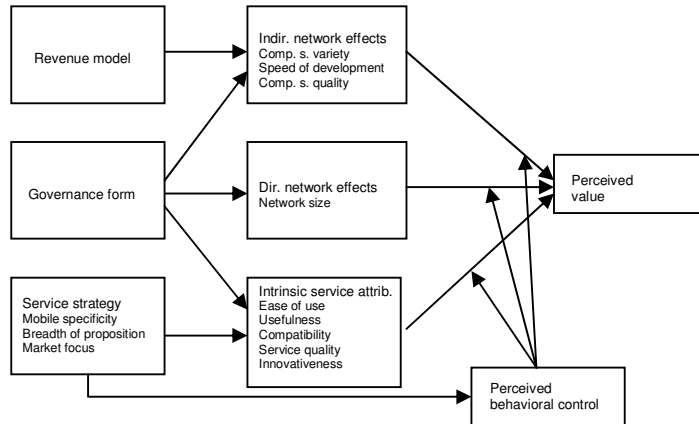


Figure 1. Research model

As shown in figure 1, we propose that business model options affect intrinsic and extrinsic service attributes, as well as perceived control. Furthermore, we propose that service attributes influence perceived value, but that the relationship between service attributes and perceived value is moderated by perceived control. In this paper, the relationships between business model dimensions and service attributes are focused.

Here, the business model concept has been operationalized along three dimensions. For the financial arrangement dimension we focus on the *revenue model* including revenue valuation and sharing. Content based valuation means that end-users pay per unit of the service content delivered, whereas transport based valuation means that end-users pay for the amount of time online, packet charge or similar volume units. A content oriented revenue share indicates that a relatively larger proportion of revenue is redistributed to content providers, whereas a transport oriented revenue share indicates that a relatively larger proportion of revenue is redistributed or retained by network or transport providers. Because the value network for mobile data service involves complementary services, we assume that complementary service variety, quality and speed of development will be obtained by stimulating the providers of these services. Another issue is that network or platform providers may use access costs as an instrument when regulating service providers' access to the network or platform (Rochet and Tirole, 2002; Foros, Kind and Sjørgard, 2002). We assume that mobile data services markets have a two sided structure where platform or network providers recognize the need to stimulate innovation in complementary services and that revenue sharing contributes to this. Thus, we propose:

1a-c: Using content oriented revenue models increases complementary service variety, quality and speed of development

For the infrastructural dimension, we focus on *governance form* as treated in new institutional economics and organization theory. In this literature, three forms are distinguished: market, relational and hierarchy forms (e.g. Ghosh and John, 1999). However, governance form is a complex element. Relational governance, for instance, includes so many options that it may be treated as a separate element in the infrastructure dimension of a providers business model (Pedersen, 2001). We suggest that the hierarchy versus relational and market forms categorization is better understood as a continuum rather than a discrete categorization of governance forms. Literature on governance forms in network markets as well as resource based theory suggest that complementary service variety and diversity is better obtained using open forms of collaboration (e.g. Schilling, 2003). Zahra and Nielsen (2002) found that relational forms increase development speed. In addition, when involvement and formal coordination are included as moderators, market forms of governance also increase development speed. Service quality on the other hand, may come out of the service integrator's control, or service quality may not be related to perceived quality elements when governance is left to market or relational forms (Dyer and Singh, 1998; Ghosh and John, 1999, p. 137). Thus, we propose:

2a-b: Using relational and market governance forms increases complementary service variety and speed of development

2c: Using hierarchical governance forms increases complementary service quality

Governance form is also expected to influence direct network effects. For example, Frels et al. (2003) found that professional consumers in business markets are able to assess direct network effects through the strength of the user network of operating systems. Gallagher and Wang (2002) suggested mindshare is an important proxy used by professional consumers to assess future direct and indirect network effects. We suggest that firm size is a moderating variable in the relationship between governance form and direct network effects in that size is required to make the hierarchical governance forms trigger direct network effects in the form of end-user network size and speed of development of complementary services. Thus, we propose:

3a: For larger firms hierarchical governance forms increase end-user network size

Governance form is also expected to influence intrinsic attributes. The product innovation literature suggests that innovativeness is promoted both in the complements and platform markets through the use of relational and market governance forms. Also, a study by Srinivasan, Lillien and Rangaswarny (2002) found that a hierarchy culture is negatively related to technological opportunism whereas an adhocracy culture is positively related to technological opportunism. Because these culture forms are derived from governance forms, the findings support the following hypothesis:

4a-b: Using relational and market forms of governance enable providers to offer more innovative, useful services than if using a hierarchical governance form

On the other hand, relying on relational and market forms of governance may make platform providers and individual service providers lose control of the production and distribution process of their service. Furthermore, compatibility and intrinsic quality may not be obtained by relying on standards that may be interpreted differently by different providers

collaborating using relational and market forms of governance. For example, Sahay and Riley (2003) found that vertical integration leads to increasing focus on customer interface standards, but they found no support for their hypothesis that vertical integration leads to less focus on compatibility standards. Thus, relying on transaction cost theory, we suggest:

5a-c: Using hierarchical governance form increases the ease of use, compatibility and intrinsic quality of services

The product innovation and customer relationship dimensions may be treated under the common term *service strategy*, including service value proposition corresponding to the positioning option often used in the marketing literature (e.g. Gosh and John, 1999), and market focus corresponding to Porter's (1985) generic strategy elements. The options for the service value proposition are service dependent and related to the specific gratifications sought by mobile data services. We suggest two options: mobile-specificity (uniqueness) and proposition breadth (scope). For the market focus options, we apply the focused versus undifferentiated options suggested by Porter (1985).

We suggest that the potential for creating higher value among end-users is greater when the service offerings are mobile specific. This means that the services are designed to meet the unique gratifications expected from mobile services. Thus, we propose that this will be reflected in the potential ease of use, usefulness and quality of the service. Thus, we propose:

6a-c: Mobile-specific value propositions increase ease of use, usefulness and intrinsic service quality

Mobile specificity may require focusing the service offering, but research shows that a variety of gratifications is expected from mobile data services (Leung and Wei, 2000; Nysveen, Pedersen and Thorbjørnsen, 2005). However, trying to fulfill a variety of gratifications may result in more complex services with less mobile specific usefulness and lack of service quality. Thus, we suggest:

7a-c: Value propositions with greater breadth reduce ease of use, usefulness and intrinsic service quality

For the market focus options, we suggested applying the traditional categorization of focused versus undifferentiated market strategies from Porter (1985). In general, a focused strategy makes it easier for the provider to adapt their services to the requirements and qualifications of end-users. We suggest that successful adaptation to market requirements is reflected in the perceived behavioral control of end-users. Perceived control is assumed to be influenced by end-users' experience, resources and self-efficacy. In general, we suggest that due to a better adaptation of services to experience, resources and skills:

8a: Using focused market strategies increases perceived behavioral control.

All hypotheses on the relationship between business model dimensions and service attributes have been formulated as direct relationships. However, it is likely that these relationships are moderated by service categories as well. For example, Brousseau and Quelin (1996) suggest that "*the success of an information-intensive service is based on its intrinsic quality... there are no network externalities ... therefore, when possible, a single firm should seek to become a core firm*" (Brousseau and Quelin, 1996, p. 1223). Consequently, Brousseau and Quelin (1996) suggest a hierarchical governance form will be best suited for obtaining

intrinsic quality of services that are not characterized by network effects. However, we have decided not to propose specific hypotheses on how relationships between business model dimensions and service attributes are moderated by service category, and suggest *moderated relationships* may be investigated as exploratory research questions.

As seen from the hypotheses, three categories of service attributes are defined. For *indirect network effects* we suggest that the attributes of the complementary services network include complementary service variety, -quality and speed of development. For *direct network effects* we suggest that the attributes are related to end-user network size and speed of diffusion. While several *intrinsic attributes* were discussed in section 2, our hypotheses focus mobile specific usefulness, service quality, ease of use and compatibility. In addition, an effect on the moderating factor of the model in figure 1, *perceived control* (e.g. Taylor and Todd, 1995) is proposed.

The model is based on rationalistic assumptions suggesting that end-users adopt mobile data services because of high *perceived and anticipated value*. Value perceptions reflect the value assessments that are made from current intrinsic and extrinsic service attributes whereas anticipated value reflects expectations of further development of these attributes. In this paper, however, the focus is on the supply side of the model investigating how business model dimensions affect service attributes

4. Method

To study both sides of the model in figure 1, a research design including six services using subjects on both sides of the two-sided market was developed. Here, we focus on the supply side study of this design. The subjects were recruited among service provider professionals of the two leading Norwegian carriers and among the leading providers of mobile data services. The 54 subjects were recruited due to their knowledge of the business models of each of six individual mobile data services. These services were presumed to differ in how intrinsic and extrinsic attributes contribute to perceived value, and thus, according to our hypotheses – in successful business models. The value of *person to person MMS* and *SMS chat* services were presumed to be particularly influenced by direct network effects related to network size, whereas the value of *MMS content* services and *POS payment* services were presumed to be particularly influenced by indirect network effects related to service complementarity. Finally, the value of individual *Java games* and *cash card charging* services were presumed to be particularly influenced by intrinsic service attributes such as ease of use, usefulness and service quality.

A paper-based questionnaire was designed and distributed by mail to the subjects agreeing to participate. It included scales for the 15 constructs relevant on the supply side of the model in figure 1 and for three manipulation check variables reflecting the respondents' classification of the service they were responsible for. The extent to which respondents consider *direct network effect* attributes as characteristic of the service was measured ($\alpha=0.81$) with two items collected from the measure of direct network effects used by Sahay and Riley (2003) with acceptable reliability and validity. For *indirect network effect* attributes ($\alpha=0.91$), items were adapted from the same study by Sahay and Riley (2003). To measure perceptions of *intrinsic attributes* ($\alpha=0.74$), two items were used reflecting the perceptions of the importance of attributes of the “service itself” relative to the importance of direct and indirect network effect attributes in creating service value.

As illustrated in table 1, manipulation checks showed that our subjects perceived the six services as belonging to our three proposed service categories.

Table 1
Analysis of variance, manipulation check variables

Variable	Group(*)	N	Mean	St. dev.	F	Sig.
Direct network effects	1	16	4.19	0.73	7.79	0.00
	2	18	3.42	0.90		
	3	20	2.85	1.27		
	Total	54	3.44	1.13		
Indirect network effects	1	16	3.50	0.97	3.74	0.03
	2	18	3.92	0.67		
	3	20	3.00	1.32		
	Total	54	3.45	1.09		
Intrinsic attributes	1	16	2.75	0.97	7.28	0.00
	2	18	3.44	0.84		
	3	20	3.93	0.95		
	Total	54	3.42	1.02		

(*) 1=MMS person to person and SMS chat service, 2=MMS content and POS payment service, 3=Java games and cash card charging service.

The measure of content oriented *revenue model* ($\alpha=0.68$) included two items focusing content versus transport related revenue sources using revenue and price as the reflective terms in the items. In addition, an item was designed focusing content versus transport based revenue sharing (Bouwman, 2003).

Heide (1994) suggests *governance forms* are second order forms that must be identified through underlying mechanisms and processes. He applied a process view focusing on relationship initiation, maintenance and termination. Thus, two items in our governance form scale ($\alpha=0.61$) were adapted from his relationship maintenance dimensions, that of hierarchical versus relational or market oriented elements in role specification and in monitoring or control procedures. The final item was an adaptation of one of the most widely applied items of the relationalism scale developed by Boyle et al. (1992).

Nysveen, Pedersen and Thorbjørnsen (2005) suggest three characteristics typical of *mobile-specific value propositions*. These characteristics may be used to develop formative scales measuring mobile specificity in the same way as has been attempted for mobile-specific service quality (Nordman and Liljander, 2003). However, we choose to design a reflective scale ($\alpha=0.85$) designed from these characteristics including components like “unique characteristics of mobile services”, “can only be successful if deployed as a mobile service”, and “the service is unique because it uses the mobile as its platform”.

To measure *breadth of the value proposition* ($\alpha=0.84$), we applied one of the differentiation items by Nayyar (1993) and designed an additional item adapted from this item with a slight variation in wording. Furthermore, one of the items measuring breadth of the product range (Nayyar, 1993) was used, and again, an additional item with slight variation in the wording was designed as a fourth indicator.

The *market focus* concept is based on Porter’s second dimension of competitive strategy – focused versus undifferentiated market strategy (Porter, 1985). Our scale ($\alpha=0.75$) used a generic item tapping this dimension that has been used by several other authors with good results (e.g. Slater and Narver, 1994). In addition, two items from Nayyar (1993) designed to measure segmented or focused market strategy were adapted to our setting and used as two additional reflective items. Finally, a reversed item covering broad market strategy was adapted from Slater and Olson (2000).

A measure very similar to the reflective measure of Cronin, Brady and Hult (2000) was developed for both *intrinsic service quality* ($\alpha=0.85$) and *complementary service quality* ($\alpha=0.94$). The items were designed as three bipolar adjectives covering reflective dimensions

of service quality. Our measure of *complementary service variety* ($\alpha=0.82$) was adapted from the measure of the size of the complements network used by Frels et al. (2003) with good results. However, our measure focuses somewhat more directly on complementary service variety. It was designed with three items reflecting the dimensions of complementarity as consisting of “other services”, “different services” and a “variety of services” partly adapted from Shankar and Bayus (2003). Authors have also studied the increase in available complementary services and products as a function of an increase in the sales of the platform product (Sahay and Riley, 2003). We consider these elements as a third dimension of indirect network effects related to the *speed of development in complementary services*. Reframing one of the items used by Sahay and Riley (2003), and adding and adapting two items related to the current and future expectations of the increase in availability of complementary services from Frels et al. (2003), we designed a reflective measure ($\alpha=0.86$) of speed of development in complementary services.

Shankar and Bayus (2003) suggest that direct network effects are a function of *network size* defined as the installed base and *network strength*, which is defined as the marginal impact of a unit increase in network size on demand. Our measure of network size ($\alpha=0.75$) was based on similar ideas and included two items reflecting perceived size of the user base. Similar items have been used by e.g. Frels et al. (2003).

Usefulness was measured ($\alpha=0.84$) using three items covering the original dimensions of time saving, improvement and usefulness suggested by Davis (1989). *Ease of use* was measured ($\alpha=0.86$) using four items developed from adapting the original items of Davis, Bagozzi and Warshaw (1989) to our setting. *Compatibility* (Rogers, 1995) has been investigated in numerous studies of technology adoption (Moore and Benbasat, 1991; Chin and Gopal, 1995). Our measure ($\alpha=0.57$) was based on adapting the items of Moore and Benbasat (1991) to the mobile context of our services. The *innovativeness* measure ($\alpha=0.89$) was designed with three reflective components collected from the product innovativeness literature (innovativeness (Garcia and Calantone, 2002), radicalness (Srinivasan, Lilien and Rangaswamy, 2004) and newness (Olson, Walker and Reukert, 1995), and was presented to the subjects through bipolar adjectives. Our measure of *behavioral control* ($\alpha=0.79$) was almost identical to the measure applied by Battacherjee (2000) and Taylor and Todd (1995). The same items have also been applied in previous studies of mobile services (Nysveen, Pedersen and Thorbjørnsen, 2005). All scales except compatibility showed reliability acceptable in exploratory research (Hair et al., 1998). Further analysis of the measurement model applying confirmatory factor analysis revealed, however, that the reliability of this item also was acceptable.

Because most of the items used to measure service attributes have been used before, we assume that they are sufficiently valid. The business model dimension scales, however, were designed for this study in particular, and further analysis of validity was required. The results of an exploratory factor analysis of these scales proved to be consistent with the hypothesized structure of items. The results are shown in table 2.

Table 2
Factor analysis, business model dimension scales

	Components				
	1	2	3	4	5
Revenue model 1	.048	-.123	-.118	.766	.022
Revenue model 2	-.142	-.106	-.034	.810	-.030
Revenue model 3	-.079	.168	.101	.637	-.063
Governance form 1	.143	-.161	-.116	-.328	.671
Governance form 2	.062	-.307	-.091	-.043	.738
Governance form 3	-.216	.092	.018	.185	.743
Mobile specificity 1	.126	.836	.149	.077	-.024
Mobile specificity 2	.218	.779	.051	.055	-.261
Mobile specificity 3	.089	.889	.018	-.217	-.082
Breadth 1	.700	-.371	-.035	-.335	-.047
Breadth 2	.882	.192	-.029	-.054	-.107
Breadth 3	.881	.197	.050	-.067	.159
Breadth 4	.806	.183	-.035	.064	-.048
Market focus 1	-.045	.097	.579	-.331	.002
Market focus 2	-.143	.138	.875	.154	-.160
Market focus 3	.072	.257	.831	.006	-.153
Market focus 5	.081	-.365	.674	.034	.133

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Values above 0.4 are marked grey. Eigenvalues (% of variance): 3.61 (21.2), 2.99 (17.6), 2.12 (12.5), 1.73 (10.2) and 1.36 (8.0).

The analysis in table 2 demonstrates that the business model dimension scales show acceptable convergence and discriminant validity. Thus, our measures may be used for further tests of the proposed hypotheses.

5. Results

All hypotheses were tested applying regression analysis including all the business model dimension variables and one dependent variable for each analysis. Intercorrelations among business model dimensions showed that multicollinearity was not a problem. To simplify presentation of these analyses, table 3 shows the standardized regression coefficients for each of the independent variables in each of the regression analyses using service attributes and, finally, behavioral control as the dependent variables. The hypotheses related to each of the analyses, the explained variance of the individual models, and the levels of significance in tests of the hypotheses are also indicated.

Table 3
Results of regression analyses

Dependent	Hyp	R ²	Business model dimensions				
			Rev. model	Gov. form	Mobile specificity	Breadth	Market focus
Comp. s. variety	1a, 2a	0.04	0.04	0.01	-0.06	0.23	0.11
Speed of dev.	1b, 2b	0.24	-0.2*	0.03	-0.54***	0.06	0.1
Comp. s. quality	1c, 2c	0.14	-0.06(*)	0.04	0.27*	0.14	0.32**
Network size	3a	0.08	0.03	-0.02	0.23	0.26*	0.07
Ease of use	5a, 6a, 7a	0.01	0.03	-0.01	0.23	-0.22(**)	0.06
Usefulness	4b, 6b, 7b	0.19	0.19	0.28**	0.48***	-0.03	0.14
Compatibility	5b	0.02	0.17	0.03	0.05	-0.12	-0.2
Service quality	5c, 6c, 7c	0.06	0.15	0.15(***)	0.29**	-0.25*	-0.15
Innovativeness	4a	0.27	-0.07	0.11	0.52***	0.09	0.18
Behavioral control	8a	0.07	-0.11	0.01	-0.11	0.11	0.04

*, ** and *** indicate significance at $p < 0.10$, $p < 0.05$ and $p < 0.01$ levels, respectively. Brackets indicate that significance is found for the *interaction* term of the corresponding business model dimension variable and service category.

As seen from table 3, explained variances are generally low. We also find that revenue model only influences speed of development. The finding is in the opposite direction of that proposed in hypothesis 1c. We find that governance form only significantly influences service usefulness, supporting hypothesis 4b. Furthermore, mobile specific value propositions is the most influential business model dimension affecting speed of development negatively and complementary service quality, usefulness, intrinsic service quality and innovativeness positively. These findings support hypotheses 6b and 6c. Breadth of value proposition influences network size positively and service quality negatively, supporting hypothesis 7c. Finally, market focus influences complementary service quality, but this relationship was not hypothesized. Consequently, only four of 19 hypotheses were supported.

We proposed moderated relationships between business model dimensions and service attributes may be investigated as exploratory research questions. These research questions were explored applying analysis of covariance including interaction terms of business model dimensions and service category. The analyses revealed additional support for hypotheses 1b, 5c, and 6a. Thus, when controlling for service category, revenue model influences complementary service quality ($F=2.61$, $d.f.=2$, $p=0.08$), governance form influences intrinsic service quality ($F=5.18$, $d.f.=2$, $p<0.01$), and mobile specificity influences ease of use ($F=3.36$, $d.f.=2$, $p<0.05$). Thus, either moderated or universal support was found for seven of the 19 hypotheses.

In an exploratory investigation of this kind, both supportive and unsupportive findings are of interest, and our findings may be summarized in the following conclusions: First, it is possible to categorize mobile data services according to the importance of direct network effects, indirect network effects and intrinsic attributes in creating customer value. Service provider professionals' categorization of services corresponded well with this proposed categorization scheme. Second, business model dimensions seem to explain only a minor part of the variation in service attributes. Thus, variation in service provider professionals' perception of service attributes not explained here may stem from other sources, such as

structural determinants or horizontal forms of governance (horizontal collaboration). Third, of the business model dimensions investigated here, mobile specificity is by far the most important in influencing service attributes. Four, governance form does not seem to consistently influence extrinsic attributes, but has an effect on intrinsic attributes, in particular service usefulness and quality. Finally, the relationships between business model dimensions and service attributes seem to be moderated by service category.

6. Implications

Our findings have several implications for industry professionals and decision makers. The fact that service providers classify services in categories corresponding to the importance of intrinsic versus extrinsic sources of customer value suggest that they pay attention to network effects during business model design. However, they don't seem to agree on how business model decisions influence service attributes. On this issue, further research is required. In particular, studies based on industrial data of business model dimensions and customer data on service attributes may be used to clarify which of the perceived relationships we have identified are valid and which are false. Still, service provider professionals seem to agree on the importance of the mobile specificity dimension, and partly, on the importance of governance form. Of these, more attention should be paid to the mobile specificity dimension. Further analysis of our demand side data shows that currently, end-users seem to lack the knowledge or experience required to assess the value of extrinsic attributes of mobile data services. Thus, they pay most attention to intrinsic attributes in their value assessments. Mobile specificity is the most important business model dimension influencing intrinsic attributes, and consequently, service providers should pay most attention to developing and offering services with gratifications that are mobile specific, such as accessibility, personalization and information dissemination (Nysveen et al, 2005). Business model dimensions also seem to affect service attributes differently for different service categories. Thus, one may not be able to identify universally successful business models. It seems that the position taken in the introduction to this paper, that open business models are more successful for some services under some structural conditions and closed models are more successful for other services under other structural conditions, is correct. Even though structural conditions have not been investigated here, the proposed research model provides a basis for discussing conditions for successful business models of different categories of mobile services.

Even though this study is exploratory, and further research is required, the conclusions are promising when it comes to conducting more confirmatory research on the issues raised here. First of all, the research model suggested here may be used as a basis for further explorations of the relationship between providers' choice of business model and customers' perception of service value. Also, the measures developed here, and our principles for categorizing services, may be used in more formal approaches and broader surveys. Finally, the findings suggest that investigating business model dimensions given little attention in previous research, such as mobile specificity, provides fruitful avenues for further empirical research on value creation in mobile data services.

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