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Structural Analysis of Value Creation in Software Service Platforms

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Abstract: As software service platforms grow in number of users and variety of service offerings, it raises the question of how this phenomenon impacts the value obtained by users. This paper identifies system usability, service variety, and personal connectivity to be the major determinants that contribute to the value offered to users on mobile software service platforms. A structural equation model, which is based on utility theory, technology acceptance theory, and the theory of network externalities, has been constructed from seven observed constructs, reflecting the three determinants and the user value. The lower bound of user value is estimated through the user's willingness-to-pay for services and the user's willingness to spend time on using services. For the validation, a co-variance-based structural equation analysis has been conducted on online survey data of 210 users of mobile service platforms (e.g., Android, iOS). The results show that the number of services used and the number of active user connections were found to be the strongest constructs explaining user value. Perceived usefulness did not explain user value as much. In total, they can explain 49% of the value that the user receives from the platform. The implication of this result is that users' value from a software service platform cannot be explained by the technology acceptance model itself. Instead, an approach that as used in this research of integrating network externality theory, utility theory, and technology acceptance theory is necessary.

Keywords: Software Ecosystem, Network Effects, TAM, Utility Theory, Value Creation, Mobile Software Service Platforms.

JEL Classification Numbers: C13, C42, C51, C88, D46, L86, M15, M21, O32.

1. Introduction

Software service platforms are one of the highly valued technologies. In the current software service market, platforms are growing rapidly in the number of users and in the variety of services offered. As a result, users are offered a large number of functionalities and opportunities to create an unlimited number of personal connections. This is especially evident for mobile software service platforms. For example, Apple's App Store contained 1,400,000 registered iPhone apps on January 2015 (Zdnet, 2015). Google's Android operating system, which runs on most devices and competes with the iPhone platform, offered more than 1,500,000 apps via its software service market, Google Play, as of September 2015 (Appbrain, 2015a). However, it is still unknown how these software service platforms (together with all software services available and the entire user pool) impact the value obtained by users.

This problem is mainly generated from the fact that there is a lack of a well-developed definition of value creation for software service platforms. The definitions of software service ecosystems, which have been given by Messerschmitt and Szyperski (2003), Jansen et al. (2009), Baek et al. (2014), and Kim et al. (2014), simply specify software service platforms as a technological and commercial environment for creating and using services and content produced by service developers and users. The platforms are either offered free of charge or for a service fee. The software services are produced by third-party service developers and can be offered via the platform for a share of the sales price (Faletski, 2012). They did not specify in detail the value creation.

In relation to the lack of such a well-developed definition of value creation for software service platforms, three major research questions can be identified: (1) What constructs determine the user value creation in software service platforms? How can this user value be measured and quantified? What are the implications for platform providers?

The actual use of systems has been studied as a source of value creation for users and providers. In particular, studies focused on the functional benefits offered by platforms and included related factors in their models as sources of value creation. The functional benefits represented in the models cover the innovative ability and efficiency (Lee et al., 2010) as well as novelty and efficiency (Amit and Zott, 2001). However, these theoretical models did not offer any empirical analysis for these value drivers. An empirical analysis model, in the general context of technology acceptance (TAM), was introduced by Davis (1989) and was extended into a detailed model of acceptance and use of technology (UTAUT) by Venkatesh et al. (2003). TAM is a model of IT adoption that argues that beliefs such as a system's perceived usefulness and perceived ease-of-use impact attitudes toward intentions to use, and ultimately the acceptance of IT (most often measured as utilization). Therefore, TAM typically involves three hypotheses, which associate the perceived usefulness and perceived ease-of-use constructs with their influence on the outcome variables. Based on this theory, the study presented in this paper adopts these constructs for perception-based evaluations and integrates them with constructs of revealed usage behaviour that are based on other theories (i.e., network externalities and utility theory).

The role of network externalities for value creation is widely investigated by literature. Prior to the web services era, demand-side interdependencies in

communication markets were addressed by studies such as Rohlfs (1974). Following these approaches, economic theories regarding information goods stated that the usage of products in these markets is driven by the need for compatible (interoperable) products that exchange information and the need for complementary products and services (Katz and Shapiro, 1985; Economides, 1996). The concepts of complementarities and network externalities were adopted into theoretical models for IT platform leadership and value creation in e-businesses in more recent studies (Amit and Zott, 2001; Lee et al., 2010). These studies discussed either the network effect that causes a change in the benefits of users due to the use of the platform by other users, or the availability of complementary services as value drivers for both providers and consumers.

The value created through the supply of services cannot be measured directly. However, utility theory states that the relationship between the potential value of products and services can be indicated by the users' decision to spend any of their scarce resources in the process of consuming the products supplied (Coursey et al., 1987). Economic studies used the concept of willingness-to-pay to measure the expected value of consumers (Mitchell et al., 1989; Shogren et al., 1994). The assumption is that a user's willingness-to-pay indicates a lower bound of the users' valuation of services utilized (Neumann and Morgenstern, 1944; Tversky and Kahneman, 1991).

This study considers these three theories (i.e., technology acceptance model, network externality theory, utility theory) to characterize the value creation process in software service platforms. First, it identifies three categories of determinants (i.e., system usability, service variety, user connectivity). Second, it introduces constructs for those categories of determinants. For this, the paper combines the three theories, explaining partial aspects of value creation in software service platforms. The result of this analysis is that the value creation process in software service markets is significantly influenced by the personal experience of a user in relation to the system, the level of connectivity with other users, and the number of services a user can access and decides to utilize. Based on this result, a structural equation model is defined. To validate the structural equation model (i.e., the relationships between service platform users' value and a set of variables measuring their service platform use experience), the study applies co-variance-based structural equation modelling technique (AMOS) on data collected through an online survey of 210 users of mobile software service platforms.

The main contribution of this research is that it presents an aggregated structural model that is based on previously established research frameworks on IT usage, utility theory, and network externalities (Davis, 1989; Venkatesh et al., 2003; Katz and Shapiro, 1986, 1994; Farrell and Saloner, 1985, 1986; Arthur, 1989; Amit and Zott, 2001; Lee et al., 2010) and that has been empirical validated through data from mobile software services platforms. Another contribution is to suggest a new value measure (i.e., time spent by a user on a service platform) besides money spent, enabling the utilization of the concept of willingness-to-pay. Such a measure is important as, for example, mobile software service platforms are dominated by advertisement-based offerings.

The remainder of the paper is organized as follows: The next section presents a literature review. After defining software service platforms, it describes the determinants identified and user value. In Section 3, the proposed model with the research hypotheses is presented. The methodology section (Section 4) describes the survey conducted and analytical technique used in the paper. Section 5 presents the structural equation model analysis results and the discussion of the hypotheses. Finally, Section 6 concludes the paper with the findings, implications, and limitations of this study.

2. Literature Review

After giving an overview about software service platforms, this section discusses three major determinants of value and introduces, as these determinants are considered latent variables (i.e., cannot be measured directly), seven observable constructs that have been identified to measure the determinants. In addition to this, this section defines user value and discusses a proxy variable for user value. Using these constructs, multiple separate relationships between the platform users' value (estimated through the WTP) and the explanatory variables can be defined.

2.1. Software Service Platforms

A software service ecosystem consists of agents, either functioning as a unit or interact among each other within a shared marketplace (Messerschmitt and Szyperski, 2003; Jansen et al., 2009; Baek et al., 2014; Kim et al., 2014; Haile and Altmann, 2015). This interactions are enabled by a common technological platform and operated through the exchange of information and resources (Gawer and Cusumano, 2002; Jansen et al., 2009; Kim et al., 2010). Jansen and Cusumano (2013) defined a software service platform as a base technology for providing online services and enable other ecosystem participants to come together. These participants are the stakeholders of software service platforms with interrelated roles and value expectations (Haile and Altmann, 2012, 2015). A detailed description of stakeholders in the software service ecosystem has been given by Altmann et al., (2007) and Bany Mohammed et al., (2009).

Software service platform providers offer the technological and commercial environment for creating and using services produced by service developers and users. Some of these service platforms (e.g., iOS, Android, Windows Phone, BlackBerry OS, Facebook, Twitter) specialize in mobile services (apps) offered for mobile devices. Other service platforms focus either on business services used by enterprises (e.g., Salesforce.com and Microsoft Dynamics CRM) or on standalone software applications that run on personal computers (e.g., Microsoft Windows, Apple OS X). In all cases, the software services run on the platform. Although the level of calculation performed on the platform varies widely, all results are presented on the users' devices. The platforms are licensed free of charge or for a fee. The software services are usually produced by third-party developers and are offered via the software service platform for a share of the sales price (e.g., for about 20-30% (Faletski, 2012)). These relationships (i.e., the value exchange) between the three stakeholders are shown in Figure 1.

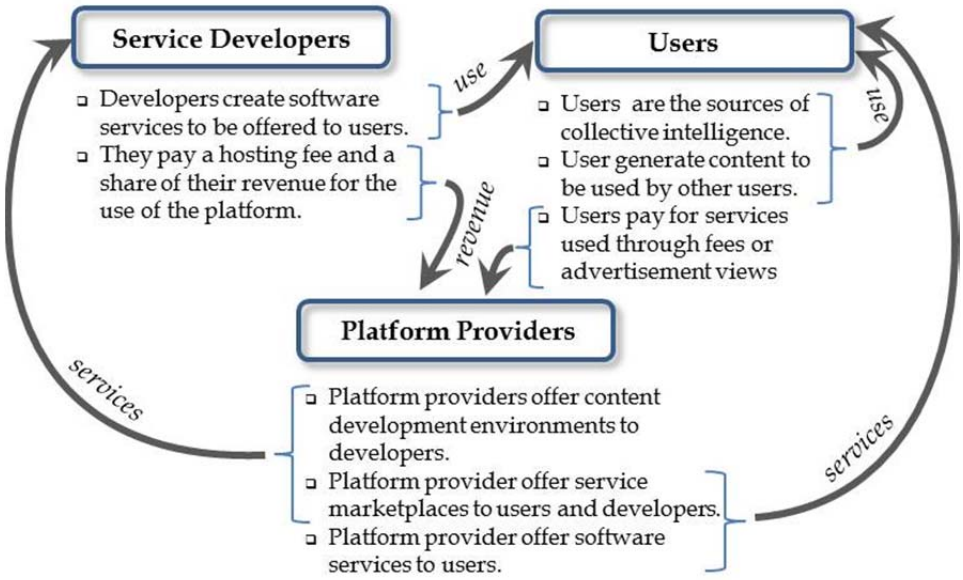

Figure.1. The stakeholders and value exchange model of software service platforms, which is an extension of the models by Haile and Altmann (2012) (2015) and Kim and Altmann (2013).

Numerous platform-native and third-party software services are provided on software service platforms (Appbrain, 2015a; Zdnet, 2015). Among the software service platform providers operating in the market, iOS and Android hold the largest shares in the mobile apps market as they are adopted by more than 1 billion users each (Forbes, 2015). The platform (together with the services offered and the user pool) generates financial and functional value to all stakeholders (i.e., users, software vendors, platform providers) involved in the market. However, the value creation model and the determining constructs of value have not been investigated so far. For example, it is not clear what constructs and how much they contribute to the user value in a software service platform.

2.2. Determinants of Value of Software Service Platform Users

Based on thorough investigation of prior literature, this study identifies three categories of determinants of value creation in software service platforms (Figure 2): system usability, service variety, and user connectivity. Each of these categories comprises of several constructs and is defined as follows:

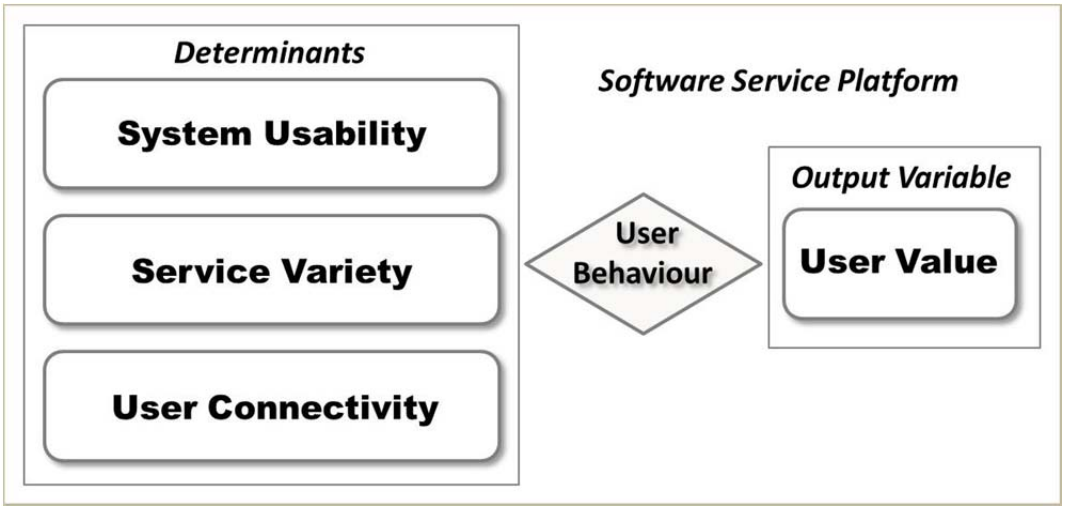

Figure 2. Determinants of value of software service platform users

System usability: System usability describes the extent, to which a system can be used efficiently and effectively (Wang and Senecal, 2007; Calisir et al., 2010). Studies like Brook (1996) introduced usability as a concept. Although usability varies in what it entails according to the context of the discussion at hand, usability can be generally defined as a level of "appropriateness to a purpose" of any particular object. However, for specifying the fitness to the purpose in a specific context (Brook, 1996), it is important to predefine the intended users, the user requirements, and the environment, in which it is used. In reference to information systems, ISO 9241-11 states constructs of usability: It focuses on effectiveness (i.e., level of achievement of user objectives), efficiency (i.e., the effort required to achieve those objectives), and the satisfaction of users obtained from using the system. Drawing on these descriptions, system usability is a broader concept than merely a functional characteristic (Wang and Senecal, 2007).

As a software service platform is a type of an information system, the concept of usability can be adopted to describe the usability of a software service platform. In this context, usability means the level of effort that the user needs, in order to access, understand, and utilize a software service platform and its offerings, as well as the level at which a service platform includes offerings that fulfil the user's functionality requirements enabled by the quality of service provided (Zeithaml et al., 1990). Therefore, in this study, the usability of a software service platform is defined by the users' perceptions of its functional and non-functional performance. The perception is the difference between a user's experience and a user's expectations.

In a theoretical model of value creation in e-business developed by Amit and Zott (2001) and a model of platform leadership in Web 2.0, efficiency has been identified as one of the other major determinants. Hong et al. (2002) suggested that the attributes of efficiency and effectiveness, which are widely used as measures of usability, match the two user beliefs (i.e., perceived usefulness and perceived ease of use) introduced by TAM as determinates of users' intentions to use a technology (Davis, 1989). Perceived usefulness (PU) is the extent, to which persons believe that, using a certain technology, enhances their job performance. Perceived ease of use (PEOU) is the extent, to which an individual believes that, using a particular technology, is effortless. In general, system usability has been found to be a significant determinants associated with users'

IT/IS usage (Davis, 1989; Davis et al., 1989; Venkatesh and Davis, 1994,2000; Hong et al., 2002; Venkatesh et al., 2003). These constructs are listed in Table 1.

Service variety: Services that run over the same service platform use the same platform standards. If a user adopts a service platform, the user is offered basic functionality that enables running different and complementary services. The existence of complementarities makes platforms more attractive to their users (Katz and Shapiro, 1985, 1994; Amit and Zott, 2001; Lee et al., 2010; Farrell and Saloner, 1985, 1986; Arthur, 1989; Zhu and Iansiti, 2012; Gawer and Cusumano, 2008). Therefore, the variety of services available determines the quantity of services and service categories that a user has access to over the platform (Table 1).

As services facilitate reachability and transactions, users purchase services (Amit and Zott, 2001; Lee et al., 2010) and install them on their mobile devices. The number of services installed (SI) varies at an individual user level and indicates the value of the service variety to the user. As user value is also obtained from the use of services (Holbrook 2006), this study assumes the real value received from software services to be mediated by their actual usage, which is represented by services used (SU).

User connectivity: Current software service platforms (together with all software services installed and the entire user pool) are dominated by use scenarios that involve communication, collaboration, and exchange of information among users (Lee et al., 2010; Gawer and Cusumano, 2008; Smedlund, 2012). Connectivity enables collective value creation in software service platforms (Gruber 2008), which makes a major part of the value obtained by participating users. Therefore, the number of users that can connect with each other on a platform through different software services is an important determinant of value created. Lee et al. (2010) even stated that the success of a platform depends on the ease, with which its users can connect. However, the value of these networks to each user depends on the individual's utilization of the network. Therefore, once users become a part of these networks, their share of the value co-created depends on the frequency of their engagement with other members of the network.

Therefore, in order to measure the impact of connectivity on the value received, our study uses both the total number of personal connections users accumulate over time (stored connections (SC)), and the portion of these connections, with which they frequently interact with (active connection (AC)). For this, we do not distinguish between different software services (e.g., Facebook, Twitter, LinkedIn, email, Skype). We only consider the total number of different connections across different software services.

In summary, this study proposes that the impact of these determinants (i.e., service variety and user connectivity) on value for the users varies based on individual usage behaviour. Therefore, this study incorporates stored and active connections, services installed, and services used, in addition to perceived ease of use and perceived usefulness. Table 1 presents a summary of the value determinants and the measures considered in this study.

Table 1. Description of constructs of the three categories of determinants.

Determinant	Constructs	Description
System Usability (Bevan and Macleod, 1994; Venkatesh, et al., 2003; Haile and Altmann, 2013; Calisir, 2010)	Perceived Ease of Use (PEOU) (Davis, 1989; Davis et al., 1992; Venkatesh and Davis, 1994; Gefen and Straub, 2000; Venkatesh, 2000)	Level of ease, at which a user can discover, purchase, and utilize services on the software service platform.
	Perceived Usefulness (PU) (Davis, 1989; Davis et al., 1992; Adams et al., 1992; Segars and Grover, 1993)	Ability of services offered on the platform in relation to the user's functional and non-functional requirements.
Service Variety (Katz and Shapiro, 1985,1994; Amit and Zott, 2001; Lee et al., 2010; Haile and Altmann, 2012, 2015; Farrell and Saloner, 1985,1986; Arthur, 1989)	Services Installed (SI)	Total number of services that the user has installed on his device.
	Services Used (SU)	Number of software services that the user uses frequently.
User Connectivity (Lee et al., 2010; Gawer and Cusumano, 2008; Smedlund, 2012)	Stored Connections (SC)	Total number of contacts that a user has stored in their communication and social media software services.
	Active Connections (AC)	Number of other users, the service user communicates with frequently.

2.3. User Value

Users of software service platforms get value from their perceived usability of the service platform, the variety of services (functionalities) that they can utilize, and the connectivity they can establish with other users of the platform. Utility maximization behaviour (expected utility theory by Tversky (1979)) states that transactions occur, if a consumer's expected utility of consuming a good or a service is larger or equal to not consuming the good or service. This expected utility corresponds with the concept of willingness-to-pay (WTP). WTP is the maximum amount that a consumer would be willing to pay for consuming a good or a service. Despite the debates regarding the feasibility of measures of value, WTP is a well-accepted indicator of an individual's valuation of goods and services in market research and in the public sector (Coursey et al., 1987; Mitchell et al., 1989; Shogren et al., 1994). Furthermore, Hökby and Söderqvist (2003) found out that income tends to influence consumer WTP positively

and significantly. Hence, WTP is assumed to be constrained by an individual's wealth. Furthermore, several methods have been developed to measure consumer WTP. These methods can be classified according to whether they measure consumers' hypothetical or actual WTP and whether they measure consumer WTP directly or indirectly.

Based on this assumption, the value users receive is measured using the willingness-to-pay (Coursey et al., 1987). In this study, WTP is captured through two measures (Table 2): (a) the time spent on using services (Priem, 2007); and (b) the monetary cost of using services (Tversky, 1979). Cost of use is defined as the average daily amount of money that the user spends on purchasing services, along with fees paid for upgrading services and for accessing content such as movies, music, and games. The cost of time spent is captured as the average daily amount of time that the user spends on using the service platform and that is moderated by income level. This definition goes along with the ideas of Priem (2007), who considered the time used for consumption as a cost to the user.

WTP represents a lower bound to the value that a user gets from using a service platform. A user would not be willing to pay (i.e., spend money and time) for using a service platform, if the value obtained from the software services platform were lower than the total cost incurred (Neumann and Morgenstern, 1944; Tversky and Kahneman, 1991).

Table 2. Determinant and measures used to estimate the user value.

Determinant	Measure	Description
WTP (Coursey et al., 1987; Mitchell et al., 1989; Shogren et al., 1994)	Cost of time spent on using services (Priem, 2007)	Amount of time that a user spends on using services on average and that is moderated by income level.
	Cost of using services (Tversky, 1979)	Amount of money that a user spends on using services on average.

As service platforms are dominated by advertisement-based service offerings, using the cost of using services as the only indicator of value would underestimate the user value in such an environment. For example, among the 1.5 million apps offered on Android in September 2015, only 203,762 apps (13.4 percent) are paid apps (Appbrain, 2015). Therefore, we also added the cost of time that the user spends on average daily use of services. Based on the user's annual income, we can estimate the approximate hourly income and can multiply it with the average time spent daily to calculate the cost of time spent.

3. Research Model

This section presents the research model with its constructs and causal relationships. The causal relationships between the constructs are based on the technology acceptance theory (Davis, 1989), the theory of network externalities (Katz and Shapiro, 1985; Economides, 1996), and utility theory (Coursey et al., 1987). An overview of the research model is given in Figure 3.

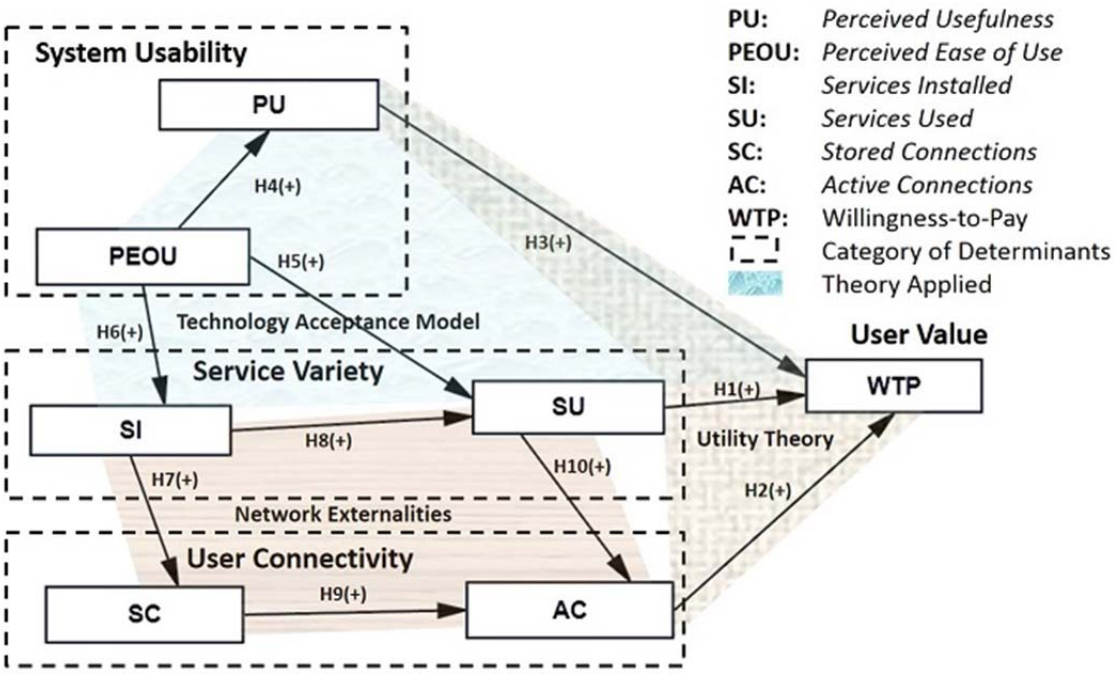

Figure 3. Research model.

In utility analysis, the assumption that the volume of consumption is related to its value is widely accepted (Modigliani and Brumberg, 1954). In the context of the use of software service platforms, this consumption volume can be represented by the number of services the user chooses to use (SU) and the number of active connections the user maintains over the platform (AC). Therefore, it is hypothesized that SU and AC are the determining factors of a user's willingness-to-pay (WTP). The corresponding hypotheses in the research model are:

H1: The number of services used (SU) impacts the willingness-to-pay (WTP).

H2: The number of active connections (AC) impacts the willingness-to-pay (WTP).

As a construct of the Technology Acceptance Model (TAM), perceived usefulness (PU) is a concept used to describe the degree to which the user believes using the capabilities of a system enhances job performance (Davis, 1989; Davis et al., 1989; Thompson et al., 1991). It has been found to be a strong predictor of use intentions of technology systems by various studies (Davis, 1989; Davis et al., 1992; Thompson et al., 1991; Vekantesh et al., 2003). It consistently correlates with users' intentions to use at the initial adoption phase and the post adoption phase. Similar results have been found in the context of continuous use of online services (Parthasarathy and Bhattacherjee, 1998). Furthermore, the intention to use a technology can also be

explained through utility theory. The intention of use simply means that there would be an increase in utility if the technology is used. Based on these findings, we can assume that, the more users of a software service platform perceive the platform and its services to be useful, the higher their WTP. Therefore, we hypothesize the impact of perceived usefulness on WTP:

H3: Perceived usefulness (PU) of the platform affects the willingness-to-pay (WTP).

In the TAM model, ease of use captures the concept of effort requirement (Davis, 1989; Davis et al., 1989), the difficulty (Thomson et al., 1991; Moore and Benbasat, 1991), and the degree of ease (Venkatesh et al., 2003), which can be associated with using a system. According to Davis (1989), the impact of perceived ease of use (PEOU) is that a system can be perceived as useful, if it is considered to be easy to use (PU). Difficulty in using and understanding makes a system to be perceived as less useful. Based on the same premise, this study hypothesised that users of a software service platform consider the platform to be useful, if they perceive the services offered to be easy to use and understandable.

H4: Perceived ease of use (PEOU) affects perceived usefulness (PU).

In the TAM and UTAUT models (Venkatesh et al., 2003, 2012), perceived ease of use (PEOU) is considered an important construct that has a positive impact on users' attitudes towards using an IT system. In some studies (Venkatesh et al., 2003; Thomson et al., 1991; Moore and Benbasat, 1991), the results regarding the impact of ease of use on use intentions were found to be significant at the early stages of adoption and became insignificant over extended use periods. As, in the context of software service platforms, various services of diverse functionalities are offered at different times over the course of a use period, different levels of effort are required to use each service by a user. Therefore, it is logical to hypothesize that perceived ease of use has an impact on the behaviour of software service platform users, which is represented by the number of services used (SU).

H5: Perceived ease of use (PEOU) has an impact on the number of services used (SU).

Based on the argument for the impact of perceived ease of use (PEOU) on intention to use a system, as explained above for hypothesis H5, it can also be hypothesized that perceived ease of use (PEOU) has an impact on services installed (SI). The more the user perceives the handling of services convenient, the more services are being tried out by the user.

H6: Perceived ease of use (PEOU) impacts the number of services installed (SI)

The theory of network effects suggests an indirect feedback loop between services provided (complementarities) and the users of a system (Katz and Shapiro, 1985, 1994; Amit, 2001; Lee et al., 2010; Farrell and Saloner, 1985, 1986; Arthur, 1989). As an increasing number of compatible services attracts more users to adopt the system, an increasing number of adopters attracts more developers to develop services compatible with the platform. Thus, a network of services enables a larger connectivity among the users. In software service platforms, many services allow users to interact through social networking and to store a large number of personal connections easily. Due to this variety of compatible services, users can be part of a wider network of users. Therefore, it can be stated that a service installed on a user's smartphone increases the

chance for the user to interact with other users. Therefore, the more services are installed on a smartphone (SI), the more connection can be stored (SC). This leads to the following hypothesis.

H7: An increase in services installed (SI) leads to an increase in stored connections (SC).

Prior studies (Katz and Shapiro, 1985; Economides, 1996) stated that the variety of services, which is given in a platform, is a source of network externality. This means the utility derived is an increasing function of the number of the services (Farrell and Saloner, 1985; Katz and Shapiro, 1985; Economides, 1996). This theory of network externalities is considered by recent works of Gawer and Cusumano (2008), Lee et al. (2010), and Zhu and Iansiti (2012), in order to examine the value sources of platforms. In software service platforms, if users find their chosen platform to provide them with services with diverse functionalities, users will install more services and, ultimately, be able to perform more of their desired tasks. As a result, the more services (SI) are installed on their devices, the more the users are encouraged to use the services (SU). These thoughts lead to the hypothesis:

H8: The number of services installed (SI) impact the number of services used (SU).

The number of users, as the second source of network externalities, is explained by the same studies (Katz and Shapiro, 1985; Farrell and Saloner, 1986). As users are able to build a wider network on the platform, the more utility they can derive from connecting over the platform. With respect to software service platforms, the number of active personal connections that a user can maintain is determined by the amount of connectivity the user is able to make through various services offered by the platform. Based on this observation and literature, this study hypothesizes that:

H9: An increase in stored connections (SC) of a user leads to more active connections (AC).

As services used (SU) enable the connectivity of users to other users, it can be stated that, the more services a user uses frequently, the more likely a user decides to maintain connections to other users through the platform. This idea has been supported by Lee et al. (2010), who suggested an interaction between complementary services and connectivity in their value model. Based on this, the following hypothesis is defined:

H10: Services used (SU) affects the number of active connections (AC).

In general, the model presented accounts for all causes of user behaviour in the context of a software service platform. This averts the concern for endogeneity, a bias created when a random variation of an independent variable does not change the dependant variable while other variables are held constant.

4. Methodology

4.1. Survey

A user survey was conducted from May 1st to May 31, 2013 to collect the data for the analysis. As the objective of the study was to show the applicability and usefulness of the research model (i.e., to show the need for considering utility theory and network

externality, besides the technology acceptance model, for estimating the user value), all smartphone users could be targeted to participate in the survey. The ownership of a smartphone satisfied the objective of the study.

The online survey was distributed and administered through social media networks and emails. The paper employed nonprobability convenience sampling. The initial subjects of the survey were selected among members of the TEMEP department of Seoul National University based on personal relationships with the authors. These initial set of subjects, which comprised 30 people, were also asked to forward the survey to their contacts via email and Facebook. This snowball technique, which expanded quickly the network of respondents, was employed to progressively attenuate the possible initial bias from the convenience sample (Heckathorn, 1997). It reached 210, heterogeneous, international respondents in 15 countries. The reliability of estimates from snowball sampling or network sampling technique and its ability to reduce bias is proven by studies such as Wejnert and Hackathon (2008).

The survey questionnaire was designed based on studies, which utilized structural equation modelling to estimate survey results (Post and Kagan, 2007; Van der Heijden et al. 2003). In these studies, a combination of listed choices and Likert-scale based questionnaire items are used as measurement methods. Following these formats of questionnaire items, this survey included 14 questions, comprising 6 questions about respondent profiles (i.e., gender, age, occupation, income level during the past year, time of first use of smartphone, type of mobile platform used), 2 questions about the output variable, and 6 questions about the constructs. (The questions are listed in Appendix A.) All items in the online questionnaire were set to be required to prevent incomplete responses and accompanied by help texts explaining the questions. This approach helped collecting usable responses.

The questionnaire items were pre-tested through a pilot survey involving 20 members of the IT services research group at Seoul National University, in order to monitor time management, check question appropriateness, and verify the ease of understanding of questions. The questionnaire items were improved according to comments obtained. For example, the questions regarding the perception of ease-use and usefulness were reduced to one for each construct after their similarities were pointed out. Furthermore, a time limit (“during the last month”) had been added to the question regarding the number of active connections as the question was prone to misunderstandings as it was.

Table 3 shows the data types and measurement methods used to capture the values of the constructs considered in the research model.

Table 3. Measurement type used for collecting data for constructs considered in the research model

Constructs	Measurement Method
Perceived Ease-Of-Use (PEOU)	Likert scale (1-5) [-]
Perceived Usefulness (PU)	Likert scale (1-5) [-]
Services Installed (SI)	20 Intervals, Range (1-200) [service]
Services Used (SU)	8 Intervals, Range (0-21) [service]
Stored Connections (SC)	15 Intervals, Range (1-1500) [connection]
Active Connections (AC)	10 Intervals, Range (1-100) [connection]
Output Variable	**Measurement Method**
Time Spent (WTP1)	17 Intervals, Range (0-8) [hours]
Money Spent (WTP2)	6 Intervals, Range (0-25) [US$]
Respondent Profile	**Measurement Method**
Income	11 Intervals, Range (10K-100K) [US$]

Data regarding each construct is captured using one questionnaire item. The output variable WTP is based on two questions and the income of the respondent profile. The WTP is calculated based on the time spent and the money spent.

4.2. Descriptive Statistics

In total, 210 responses were received. The characteristics of the respondents are 90 students (43%), 54 employees of private companies (26%), 51 government employees (25%), and 15 self-employed (6%). All of the respondents are smartphone users, among them 162 (77%) have been smartphone users for more than a year. The respondents of the survey are users of different mobile service platforms: 49 (23%) Apple iOS users, 117 (56%) Google Android users, 7 (3%) Microsoft Windows Mobile users, 27 (13%) RIM BlackBerry users, and 10 (5%) users of other platforms.

In order to collect data on perceived usefulness (PU) of services, respondents were asked using a 5 Likert scale, whether they consider services offered over the platform of their choice useful. Users found services useful, as 78% of them indicated an increased satisfaction. *Perceived ease of use (PEOU) of services* was also measured using a 5 Likert scale. They were asked whether they find their service platform easy to use. Users experienced use easy, as 76% of them indicated an increased satisfaction as well. With respect to the ease of use among users of different service platforms, 76 (64%) of Android users and 37 (75%) users of iOS users expressed the highest ease of use.

In response to inquiries regarding the number of services installed (SI) and the number of services used (SU), the highest percentage of users (23%) indicated that they have 11 to 20 services currently installed on their smartphones. 72% of all subjects had 21 to 40 services installed at the time the survey was conducted. 73 (41%) of the respondents indicated they use on average 4-6 services per day and 60 (34%) of them said they only use 1-3 services per day. In summary, 75% of our respondents used less than 6 services per day.

Respondents were asked how many communication connections they maintain on their smartphone. This includes communication connections through social media and communication apps. 16% of the respondents said they have 201 to 300 connections and another 16% of them had 101 to 200 total number of connections stored (SC) in their devices. With another question, they were asked about how many of those connections they used within a period of a month. The answers show that 25% of the respondents interacted with 11-20 of their connections, 23% indicated 1-10 connections, and 20% communicated with 21-30 of their connections.

The users' willingness-to-pay (WTP) for services is measured through the amount of money spent and the time that they spent on services. With respect to the amount of money spent on purchasing services, the survey reveals that only 39% of the subjects had purchased services. In addition to this, only 41% of the subjects have paid a usage fee for mobile data transfer. The peak frequency on the time spent on services is the range from 0.5 hours to 1.0 hour. 35 subjects (20%) indicated this range. The second highest frequency with 32 subjects (18%) is the range from 1 hour to 1.5 hours. However, 71 of our respondents (41%) spent more than 2.5 hours a day on using services on their smartphones.

Prior to the use of the values within the analysis, all observations of variables were normalized to indicate relative levels. The following table presents the mean of the values and variability of the data.

Table 4. Summary of descriptive statistics.

Construct	Mean	Std. Deviation
PEOU	0.721	0.275
PU	0.735	0.259
SI	0.207	0.231
SU	0.248	0.185
SC	0.335	0.262
AC	0.304	0.277
WTP	0.018	0.023

Legend: PEOU= Perceived Ease of Use; PU= Perceived Usefulness; SI= Services Installed; SC= Stored Connections; SU= Services Used; AC= Active Personal Connections; WTP= Willingness-to-Pay

Although the survey resulted in a small data sample to clearly represent the whole population of mobile service users, it included a good distribution of possible behaviours of new and experienced mobile service users. All 210 samples were valid records, which could be used in the analysis.

4.3. Structural Equation Modelling

This study employed the structural equation modeling (SEM) technique, in order to test and estimate the causal relationships between determinants of users' values and theoretical causal assumptions adopted from related literature. Hwang et al. (2010) concluded that Covariance Structural Equation Modelling (C-SEM) has been found not

only to recover loadings, parameters, and path coefficients better than other techniques but also produces unbiased parameter estimates. Implementation of C-SEM using Analysis of Moment Structure (AMOS) software is recommended. AMOS is one of the software solutions widely used to perform structural equation modelling and analysis. This is due to the fact that it provides an environment to easily create structural and measurement models for investigating the underlying relationships among elements of the models. It also provides rigorous model fit measures.

As our study utilizes the AMOS technique's capacity to test the fit of the empirical data to the model, the maximum likelihood method is used for fitting the model, estimating parameters, and testing the hypotheses. Complying with the procedure of measurement models in SEM, the final data analyzed comprises normalized values obtained from the corresponding questionnaire items for PEOU, PU, SI, SC, SU, AC, and the two items for WTP.

The variance analysis of the sample size of 210 cases showed a good model fit: (1) Chi^2/df=3.5 (a measure of fit between the sample data and the hypothesized model that should be close to zero (Bagozzi and Yi, 1988)) was acceptably insignificant (Wheaton, 1977); (2) The standardized root mean square of residuals is close to zero, SRMR=0.003, therefore, positively showing that the sample variances from the estimates obtained under the assumption of the model was insignificant (Hu and Bentler, 1999); (3) The goodness of fit index is GFI = 0.96, i.e., it fulfills the goodness of fit of the model by being close to 1 (Gefen et al., 2000).

5. Data Analysis

The proposed research model is empirically analysed by comparing the relative impact of the major determinants (system usability, service variety, connectivity) on utility (value) as perceived by the user. At the same time, the analysis comprises the evaluation of the inter-construct relationships.

The coefficient, relating to hypothesis i, is represented by β_i, and e_i is the residual (error in variables). It is assumed that the coefficient β_i and the e_i are uncorrelated. The coefficients show the sign and strength of the impact of a construct on another. The hypothesis i regarding the relationship between constructs is accepted or rejected based on the significance level of β_i. Among the ten relationships hypothesized, seven relationships were tested to be significant at $p < 0.001$ level and three (hypotheses H3, H5, and H6) were found to be significant at $p < 0.005$ level. Therefore, all 10 hypotheses constructed in the research model are included in the analysis.

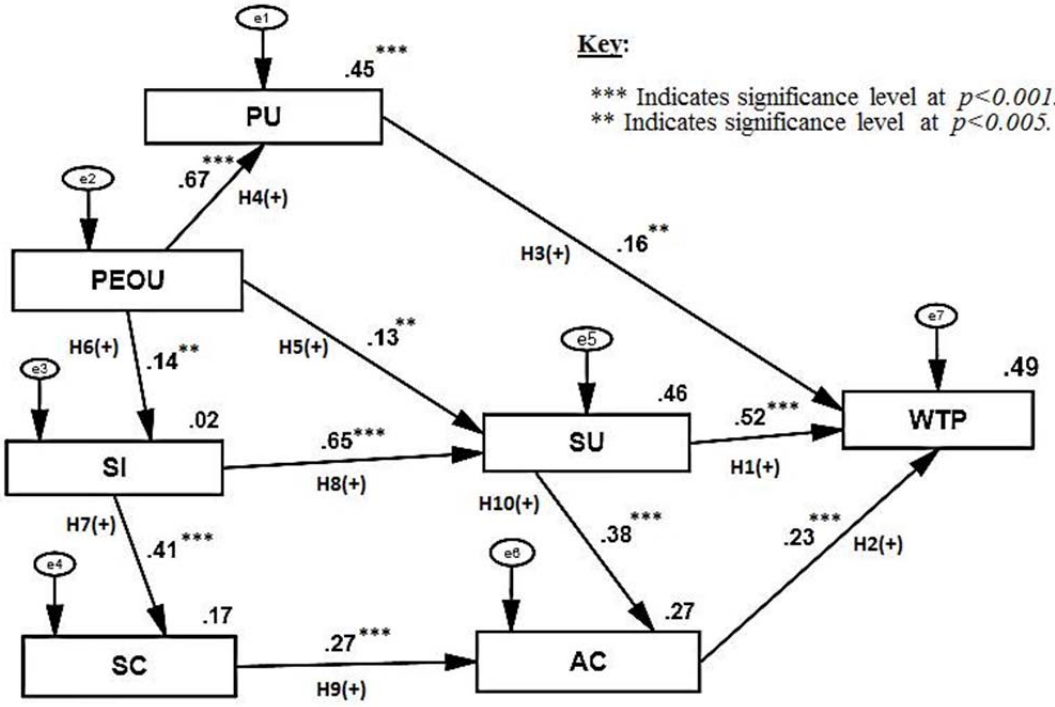

Figure 4. Standardized AMOS estimations.

Hypotheses H1 and H2 aimed at evaluating the direct impact of two constructs (i.e., number of services used (SU) and the number of active connections (AC)) on the willingness-to-pay (WTP, the proxy of the outcome variable (i.e., user value)). These two constructs represent the level of use of the software platform by users. Thus, they represent the users' valuation of the platform. The tests of these hypotheses show a strong association. The association (H1) between services used and value perceived by the users is $\beta = 0.52$. This implies that the more services users are able to utilize, the more they perceive the platform as valuable. The number of active connections users maintain showed an impact strength of $\beta = 0.23$ (H2). Although the amount of time and money they spent using the platform also increased as they maintain more personal connections, the number of services used regularly (SU) is found to be a more important determinant of user value (i.e., willingness-to-pay) than the number of personal connections maintained (AC).

With hypothesis H3, the role of perceived usefulness (PU) on the willingness-to-pay (WTP) is captured. Its association with willingness-to-pay showed a strength of $\beta=0.16$. Users also value the usefulness of their software service platforms. It is not a surprising result, as it is considered to be an important contract in the decision to use any system. However, as the impact level shows that the users' perception of the usefulness of their chosen platform did not vary as much as their willingness-to-pay did, it is found that perceived usefulness is a less significant driver of users' valuation of the platform.

Hypothesis H4 focused on capturing the impact of perceived ease of use (PEOU) on perceived usefulness (PU). The test showed a significant impact of $\beta = 0.65$. This result shows that most of the users, who considered the software platform of their choice easy

to use, also considered it useful. It also confirms the theoretical foundation of the hypothesis. It leads to the understanding that a favourable user experience enhances the perception of usefulness of software service platforms.

Hypothesis H5 explored the impact of perceived ease of use (PEOU) on services used (SU). This hypothesis yielded a less significant impact of $\beta = 0.13$. Comparing this result with the result from hypothesis H4, it can be implied that users, who found the platform easy to use, were more likely to believe its usefulness but did not influence the number of services they decided to use in a considerable way. Therefore, perceived ease of use (PEOU) is found to be a weak predictor of level of services used (SU). Hypothesis H6 focused on the impact of perceived ease of use (PEOU) on services installed (SI). Similar to the impact of PEOU on services used (hypothesis H5), the results showed that PEOU showed a weak impact on SI ($\beta = 0.14$). The data also showed only a significance level of $p < 0.005$. Therefore, it can be stated that the hypotheses H5 and H6 do not predict the users' use behaviour in detail.

The impact of services installed (SI) on stored connections (SC) was evaluated through hypothesis H7, which was found to show a significant impact of $\beta = 0.41$. This means that as the number of services users have installed on their devices increased, they were more likely to have an increasing number of personal connections stored. In hypothesis H8, the impact of the number of services installed (SI) on services used (SU) has been evaluated. SI showed even a more significant impact on SU ($\beta = 0.65$) than on SC (H7). The results on the role of SI (hypotheses H7 and H8) imply that it can be considered a good indicator of user behaviour and confirms the theoretical basis of the research model. As a larger variety of services are provided to the user, the likelihood of using more services regularly and building a wider personal network through those services increases accordingly.

Hypothesis H9 describes the impact of stored connections (SC) on active connections (AC). The test of hypothesis H9 showed a weak impact of $\beta = 0.27$. That means, users, who accumulated a large number of connections, did not necessarily maintain active interactions with more number of connections than users with lesser number of connections stored on their devices. On the other hand, according to the test for hypothesis H10, the relationship between services used (SU) and active connections (AC) showed a strong association between the two constructs ($\beta = 0.38$). This means that the more services the users are able to use, the more active personal connections they were able to maintain. The comparison of the results for hypothesis H9 and H10 indicates that the level of service used (SU) predicts the level of active connections (AC) users maintain better than the level of connections they have stored (SC).

In summary, the six constructs studied in the research model explained 49% of the variance in the willingness-to-pay (WTP) for the usage of a software service platform. The number of services used regularly (SU) and the number of personal connections maintained (AC) were significant constructs to predict the users' willingness-to-pay (WTP). Perceived usefulness (PU) showed a weak association with the user value. Number of services installed (SI) was found to be a strong determinant for both the number of stored connections (SC) and the number of services used (SU). Over 46% of the variance in services used (SU) is explained collectively by perceived ease of use (PEOU) and services installed (SI). The number of active connections users maintain (AC) is strongly determined by the number of services used (SU) than the total number

of connections they stored on their devices (SC). Along with stored connections (SC), the two variables (SU and SI) explained 27% of the variance in active connections (AC).

6. Conclusions

6.1. Findings

Motivated by the globally increasing attractiveness of software service platform use and the parallel increasing interest of developers in offering more services over these platforms, this study proposed a structural equation model explaining the value of software service platforms to users (second research question). Three determinants were chosen based on extensive review of previous research (first research question): system usability, service variety, and user connectivity. Each of those variables can reasonably contribute to value creation for users. The dependent variable, user value, is approximated by a lower bound through the users' willingness-to-pay. The willingness-to-pay is calculated as the sum of the cost of time that users spend on using the service platform and the spending on purchasing services. Using willingness-to-pay as a lower bound for the user value is reasonable to assume, as the user value needs to be higher than the cost that is incurred for a user. Otherwise, if the return in user value were lower, the user would not use the platform at all.

Based on an online survey conducted among 210 smartphone users, we validated our structural model of value obtained by software service platform users. All 10 relationships shown in the model are significant, although the three relationships (i.e., H3, H5, and H6) have a low significance level. In particular, a few results can be highlighted with respect to our second research question: First, it is also to be noted that most of the explanatory power of the model resides in the determinant, service variety. Besides the explanatory power of service variety, the explanatory power of user connectivity is stronger than the explanatory power of the determinant, system usability.

Second, the structural model analysis also showed a strong impact of the availability of services on the services used and, then, the value obtained by users. It shows that the availability of compatible services strongly predicts the intensity of the use of a mobile software service platform (i.e., spending more time and more money in the process).

Finally, although usefulness was found to have a significant association with the willingness to use the mobile service platform, which is consistent with previous findings in information systems research, the results of the study also showed that it has lower impact on the willing-to-pay than the other two determinants. This can be a consequence of the fact that most subjects considered the platform to be very easy-to-use and very useful. That means the observed perception is already very high. The averages of their corresponding survey question answers are 0.721 and 0.735 (Table 4), respectively. The little impact of system usability on willingness-to-pay implies that our model identified other determinants (and the corresponding theories), which are more important than system usability with respect to user value on software service platforms. Therefore, we can state that the technology acceptance model by itself cannot explain the entire value that is obtained by users of mobile software service

platforms. Instead, utility theory and network externalities need to be considered to explain the majority of the user value.

6.2. Implications

Our three findings suggest several implications for mobile software service platform providers (third research question). With respect to the first finding (i.e., service variety and user connectivity generate a strong drive towards value creation), it is suggested that providers need to find ways to make users use more smartphone services and, especially, smartphone services for communicating with other users. Utilization of more marketing methods for improving service discovery for users could be one possible way.

With respect to the second finding (i.e., strong impact of the availability of services on user's willingness to spend money for services and to spend time on the platform), the importance of service developers for the sustainability of the platform provider's business also becomes clear. Therefore, platform providers need to ensure sufficient incentives for service developers to continue developing different services for their platform, in order to have new types of services continuously released on their platform and, consequently, have users consume those services. It is also recommended that platform providers support service developers in developing services by the provisioning of software development environments.

Despite the third finding (i.e., relatively little impact of system usability), it is recommended that the platform providers maintain their level of quality of the platform for an effective and efficient use of services. As previous technology use studies confirmed, the perception of ease of use strongly predicts the perception of usefulness. This means the more the users perceive it to be easy to use, the more they will consider it to be useful as well. Furthermore, the smartphone users of our study already perceived the platform to be very useful and very easy-to-use. Therefore, although the direct impact on a use decision was found to be less significant, it is still an important construct of the overall experience of users. It is recommended that providers continuously put effort into the convenience and user friendliness of their platforms.

Value creation models have mainly been considered in the field of business management and, only to some extent, in information systems. However, as new ways of providing software services are introduced in the market, the value creation can be helpful in the field of information systems to explain and conceptualize new behaviours observed. With respect to this context, the implication of the study is that our value creation model offers a first step in integrating multiple established theories to explain the phenomena observed through the technological and business innovations in the field of software service platforms.

6.3. Limitations of the Study

Though efforts have been made to include subjects revealing all possible behaviours in relation to the variables of interest, this study had limitations due to its medium-sized sample. Further studies could be conducted involving a more representative sample size, which allows analysing the impact on multiple groups of subjects. For example, there may be variations of behaviour due to income levels, length of use experience, gender,

occupation, and level of education. Such an analysis could produce useful information for mobile software service platform providers on whether the strongest constructs vary across such user attributes and whether the explanation power can be improved for certain groups of users. In addition to this, the empirical data could be collected on other types of software service platforms, not only on mobile software services platforms as being done. Future studies should consider these directions.

Further research should also investigate the values obtained by software service developers and platform providers. This would allow comparing the values obtained by the different stakeholders, in order to understand whether the allocation of value between the different stakeholders is sustainable. The value allocation should provide sufficient incentives for all stakeholders to remain in the software service ecosystem.

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Appendix

A. Survey for Mobile Software Service (Apps) Users

Respondent Profile

Please specify your gender.

Please specify your age.

Please specify your occupation.

Please specify your income level during the past year (in US dollars).

When did you start using smartphones for the first time?

Which mobile service platform are you using?

System Usability

(PEOU) It is easy to find and use the apps you need among what is offered by your platform.

(PU) I find the apps offered on my platform useful.

Service Variety

(SI) How many apps do you have on your smartphone?

(SU) On average, how many apps do you use per day?

User Connectivity

(SC) How many connections (number of friends) in total do you have in your social media apps (e.g., Facebook, Google+, Twitter, LinkedIn, Skype)?

(AC) Among the above connections (friends), how many people did you communicate with during the last month?

User Value

(WTP1) On average, how much time per day do you spend using apps on your smartphone?

(WTP2) How much did you spend on average per month on usage for apps (e.g., for gaming, listening to music, watching movies)?

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