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Value Creation in IT Service Platforms through Two-Sided Network Effects

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Abstract: IT service businesses can achieve economies of scale and scope faster than in traditional product businesses. In particular, as IT service platforms will become the founding infrastructure of our economies, the analysis and understanding of the value that a service platform can generate is of great importance. IT service platforms provide all involved market participants with different values. For this paper, we consider application service users, service developers and service platform providers as market participants and analyze the interrelationship between the value creations of these market participants. The basis for the description of the values and their interrelationship is the identification of parameters. Based on these parameters, a simulation model has been developed. It helps inferring the relative impact of these parameters on the evolution of the IT service platform stakeholder values. The results imply that there is a two-sided network effect. All stakeholders of a service platform mainly benefit from a growing installed base of application users. The benefit of a large service variety, however, mainly benefits the service platform provider. Therefore, we can state that a large fraction of the value from two-sided network effects goes to the platform provider.

Keywords: IT Service Platform, Value Creation, System Dynamics, Two-Sided Network Effect, Business Modeling, IT Business, SaaS, Cloud Computing.

JEL Classification Numbers: C15, D02, D11, D46, D85, L14, L86, M15, M21, O31, O33.

1. Introduction

IT service platforms provide an enabling technology for the development and provision of application services in service-oriented environments. Examples of those service platforms are Software-as-a-Service (SaaS) platforms, Platform-as-a-Service (PaaS), and Infrastructure-as-a-Service (IaaS) platforms. As economies of scale and scope can be achieved very quickly with IT service platforms, some IT service platforms will become the founding infrastructure of our economies. Therefore, an understanding of their value creation and value distribution becomes important. In this context, one of the major challenges that business managers face is to determine the value of services and to measure the value they obtain from services they offer [1], [25].

In determining the economic values of networked services, such as IT platform services, the role of network effects is important. Direct network effects, a value generated from the number of existing users of a service, and indirect network effect, a value built by the availability and interoperability of complimentary products, are well-developed concepts in network economics. The double impact of both effects is explained through two-sided network effects. Two-sided network effects have been considered a source of value in traditional software markets. Users and providers experience value growth due to such effects. It has been argued that two-sided network effects give rise to demand-side economies-of-scale and that consumers form expectations regarding the size of competing networks. Its impact on competition, market equilibrium, and compatibility decisions among firms and adoption pace of new technologies have been widely recognized in literature [2], [3], [4], [5], [6], [7], [8], [9], [10]. A recent study also addressed the presence of direct and indirect utilities in the context of services, in particular the role of mobile app stores in application delivery environments [11]. Another study discusses the openness of services [25].

In the traditional software industry, Microsoft Windows is a very good example of the significance of two-sided network effects. Microsoft built a platform business model that utilized indirect network effects. The more windows applications are available, the more reasons for a user to choose Windows, the more reasons for developers to build applications for windows. However, for IT service platforms, interconnecting users and service integrations are more important factors than in traditional software markets. Service platforms can reach a large number of users and developers much faster. An example of that is the raise of the social network platform Facebook. A few studies have also been performed in this area [12], [13], [14], [15]. However, a comprehensive system model showing the stakeholders as well as the interdependence of their utilities has not been developed so far.

Developments in service technologies, specifically the change in the mode of delivery and the ways of use, reinforce a new way of thinking about business values [12]. For example, IT service platforms can target different user groups by designing specific pricing models, fitting the usage scenarios preferred by those different user groups.

In terms of capabilities for value creation, the characteristics of service markets are also different to those of traditional IT markets. In today's service business environments, service providers can no longer rely on simple comparisons of features, functions, and prices of their products with those of competitors, to determine their competitive advantage in the market. As values created through service integration, user content, and user networks have a significant impact, those need to be considered for the value creation analysis as well.

The main distinguishing feature of service platforms from traditional two-sided software markets is, in addition to delivering end user services, the provisioning of an environment for service developers to build functionalities and deliver them as services to end-users.

Summarizing, these unique characteristics result in new ways of value creations. Consequently, evaluation approaches need to consider these new value creations, in order to identify the competitive advantages of providers.

Theoretical value creation frameworks for e-businesses and, in particular, for service platforms have been proposed in recent literature [13], [14], [15], [16], [17], [26], [27]. A study of value creations in the general context of e-business has been conducted by Amit and Zott [13], which identified dimensions of value creations and evaluations of different business models of service platforms. User-created values have been discussed by Lee et al. [14], and a research on the value transformation in the mobile service ecosystems by Smedlund [15]. However, an evaluation of the effect of the platform value for its stakeholders, which is important for any business decision, has not been achieved with these frameworks. Hence, more sophisticated definitions of value factors and their measurable parameters are required.

Conclusively, we can state that the research works mentioned above do not fully explain the value system of IT service platforms in terms of all relevant parameters, the stakeholders involved, and the value exchange between the stakeholders. This paper aims at addressing this gap by introducing a new value creation framework for IT service platforms, which can provide a useful tool to service providers and policy makers. As the framework helps explaining the value of service offerings to application service users, service developers, and platform providers, it can also be used as decision support on investments in service offerings, investments in platforms, design of business models, service bundling policies, and market structure evolutions.

In the course of achieving its objective, this paper identifies four parameters, explaining the net value of a service to a stakeholder of an IT service platform. The four service parameters, which are quality of service (QoS), service variety, installed base (i.e., number of users), and cost, are integrated into additive utility functions for application users, service developers, and platform providers. The utility functions enable the evaluation of the value creations of a service platform. For the analysis of the relative changes of values of platform stakeholders, a simulation technique (system dynamics) was used. The analysis result implies that the value obtained by service developer is quite low in comparison to platform provider. In a mature market, the major beneficiary is the platform provider, while the application users and the service developers benefit only little. This indicates a risk that developers withdraw from the platform market, causing a market failure.

The outline of the remainder of this paper is as follows: Section 2 presents the description of the proposed model, followed by the simulation settings and results in Section 3. Section 4 concludes the paper with a brief discussion and summary.

2. Proposed Value Creation Model for IT Platforms

Our value creation model comprises three parts: stakeholder specification, value parameters, their effect on stakeholders, and the quantification of the values generated.

2.1. Stakeholders

In the IT service platform ecosystem, the major stakeholders, who contribute to the value creation, are application users, service developers, and platform service providers [28]. Even if there are other stakeholders such as brokers, service integrators, and content creators, their main role ultimately falls under one of the above-mentioned three stakeholders, who we have selected to study in this paper.

A service provider takes on the role of producing and publishing services, which are ready to be executed. In the context of this paper, both service developers and platform service providers qualify as service providers, since they own their respective services and are responsible for implementing and maintaining them. Nevertheless, they will be treated as two different stakeholders as they are at different positions in the IT platform ecosystem.

A platform provider offers an environment, in which different types of third-party services (e.g., social network services, communication services, search engine services, entertainment services, market place services, computing services, and storage services) can be executed. A platform provider also plays a role of an intermediary between a service developer and service consumers, it enables service discovery by potential customers and potential integration with other services.

Service developers, who are software vendors or individual programmers, use development kits provided by the platform service providers to create applications (e.g., social network services, communication services, search engine services, entertainment services, market place services, computing services, storage services), to be deployed on platform services.

Application service users are users of services offered by application service developers and platform service providers. Application service users aim at accomplishing a certain task through the use of an application, which match their requirements.

The value exchange between these stakeholders can be direct (i.e., direct payments for services offered and used) or indirect (i.e., revenue through advertisement), resulting in net utility for users, profit/loss for the IT platform provider, and profit/loss for service developers. The relationships among these stakeholders, which are based on a literature study, are depicted in Figure 1.

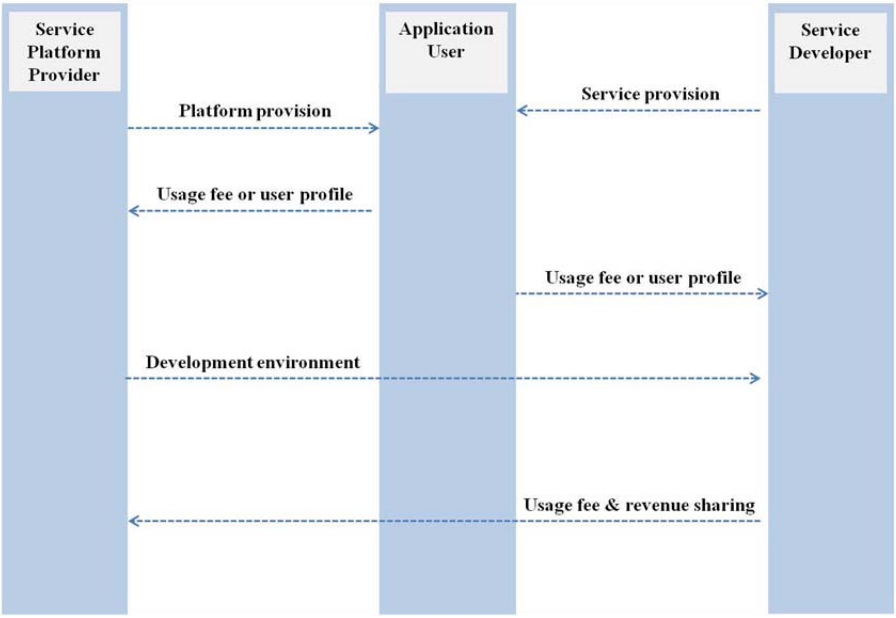


Figure 1. Value exchange of service platform stakeholders.

The value exchanged between a platform service provider and service developers comprises the provisioning of deployment and service provisioning environments in exchange for cash fees or a share of the developers' revenue obtained from their respective users. Service developers provide their services to application users for a subscription fee or free of charge but with advertisements. To both platform providers and service developers, the application service users are the major source of revenue; the revenue here comes from subscription and usage based charges or from using customer profiles for selling advertisement services.

2.2. Value Parameters and their Effect on Stakeholders

Service value parameters determine the value obtained by participants. They indicate the source of the values that have been generated from using the service platform. Understanding the impact of these parameters is important for platform providers for formulating their business policies. Existing theoretical frameworks have compared single factors and identified their interdependence [13], [14].

Based on those theoretical frameworks and concepts, this paper presents a consolidated set of measurable parameters. In detail, for building the value creation model proposed in this paper, we consider quality of service (QoS), service variety, installed base, and cost. They are used for quantifying stakeholder values and to construct the value creation model proposed in this paper (Figure 2).

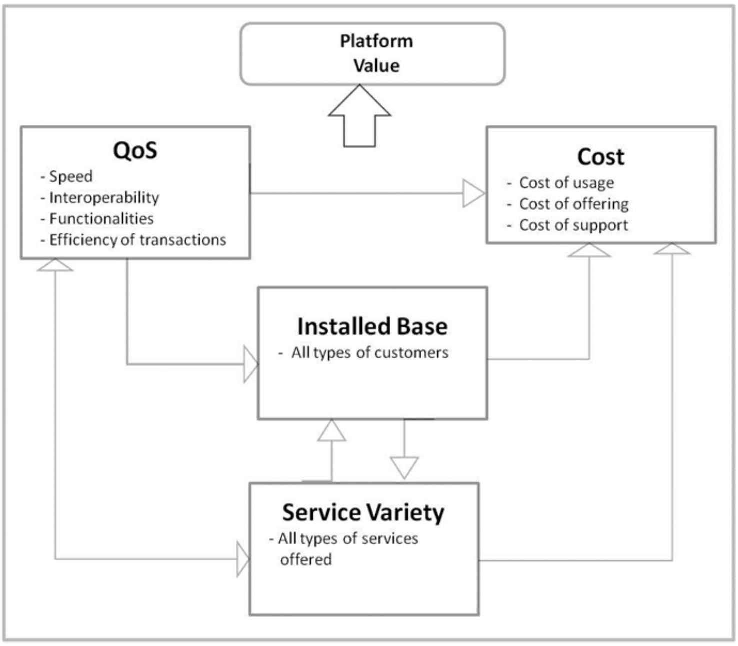


Figure 2. Service value parameters of service platforms.

As shown in Figure 2, QoS impacts the number of customers and the number of services that a service platform can attract [3], [19]. QoS is also a major factor of the cost of service development and provision for service developers and platform providers. The installed base impacts the number of service varieties to be provided through attracting more developers [23]. However, the installed base also causes cost of supporting customers. The service variety also changes the cost of offering, the cost of support, and the QoS offered, ultimately influencing the number of customers attracted.

Besides describing the value parameters in detail in the following subsections, we also explain how they impact each of the three stakeholders (Figure 3).

Quality of Service: QoS measures functional capabilities of services. It indicates whether the functionality, interoperability, and performance of a service are up to the requirements of the users and meet the intended service level objectives. With respect to software, it is to be noted that QoS also considers the quality of data that is returned by an application [18]. Quality of service is an important factor in driving the value of products. There are cases where late entrants managed to take the market leadership from incumbents by offering a better QoS [3, 19]. Similarly, the value obtained by IT service platform customers is also determined by the QoS they are offered (Figure 3). The QoS offered by a platform provider can be constant or dynamic. If platform providers invest in new functionalities to meet user requirements, they improve the quality of the development environment for service developers and service offering environment for end users.

Installed Base: Installed base represents the number of active users of a platform. The installed base affects the value of all stakeholders as a source of revenue (Figure 3). The effect of the installed base on the stakeholders' values is explained through network effects. The network effect benefits all stakeholders and attracts even more customers [10], [13], [20], [21]. Platforms with a larger number of users can leverage their user network to gain competitive advantage. Considering the time and effort a user needs to adapt to services on a new platform (e.g., social networking platforms), many users are less likely to switch platforms [13].

Specifically, network effect has been identified as an IT platform business strategy [14], [22]. For platform providers, the idea behind network effects is that customers pay more to get access to a bigger network and, as the installed base grows, so will the platform providers' revenues. Therefore, platforms with a critical mass have the advantage to stay in lead among equally innovative platforms.

The network effects that come into play in a platform environment are: The increase in the number of users is reinforced by the installed base as well as the increase in service variety due to the increase in the number of users, which, in turn, makes more users join the platform.

Service Variety: Service variety represents the availability of complementary services that users of the platform can access. Service variety is one of the value sources in platforms. If platform providers offer services, which are complimentary to services offered by the same platform, they generate a network effect, increasing the value of the platform to their potential customers as the platform's customer size increases. Availability of complementary services makes the offerings of a platform provider more valuable to their customers [13], [23]. Therefore, in order to create more value, cooperation between complementary service providers is a likely successful strategy in the service industry [24]. In sum, the idea of increasing variety of services in the context of platform services as a value driver is well supported. Therefore, we consider service variety as a value parameter in our model. Service variety impacts the platform provider's revenue and the application users' benefit positively (Figure 3).

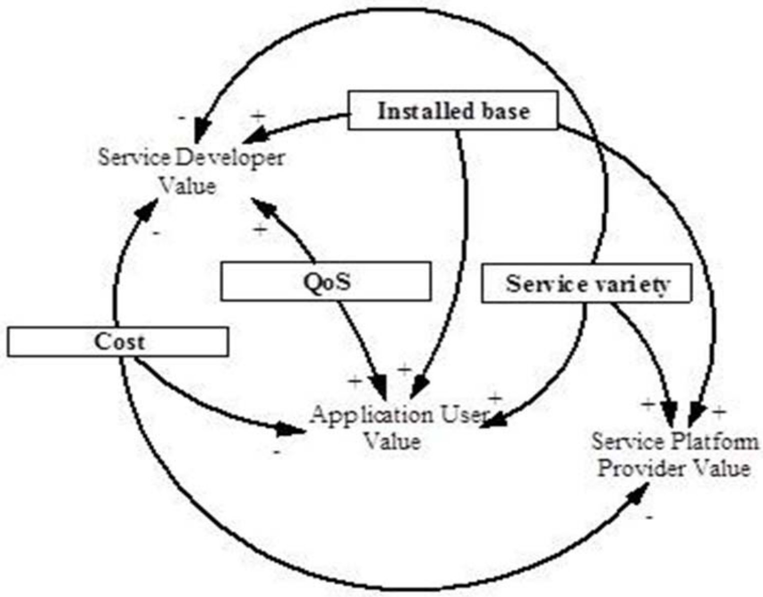


Figure 3. Effect of service value parameters on value obtained by stakeholders.

Cost: Cost is used in this model to represent all types of costs incurred by all stakeholders. Cost incurred by stakeholders negatively affects their value (Figure 3).

The usage cost of application users in the context of platform services includes the subscription and periodical fees paid by users to both of the providers.

The platform provider and service developers face costs for offering services (e.g., service maintenance) and supporting their customers in case of problems with services.

Reducing the cost of offering services (e.g., through improved efficiency) for service providers results in an increase of their net value [13]. However, in the overall platform ecosystem; the increase in the cost of one stakeholder might result in the increase in value of another. For example, if the price of an application is set high, the users' value will be affected negatively, while the service provider's revenue gain increases up to a certain threshold.

2.3. Stakeholder Value Representations

Based on the variables identified and their relationships, we construct functions quantifying the value that the three stakeholders obtain from an IT service platform.

The decision problem studied here involves one IT service platform, a fixed number of potential users and developers. The application users and service developers continuously have to decide on the adoption of the IT service platform based on the four value-determining parameters mentioned in the previous section. At each time period, new users may join the platform and subscribe to services offered. Similarly, new developers may join the platform, buy development kits, develop services, and sell their applications to the installed base of users. The value functions, representing the utility of the application user, the platform provider, the service developer, use the value determining parameters as input.

Application User Value: Based on the value creation model, we define an application user's net utility U_{ja}. It is determined by the functional benefits that they obtain from using services offered by the platform. The net utility is defined as follows:

$$U_{ja}(t) = u1_{ja}\left(Q_j(t)\right) + u2_{ja}\left(S_j(t)\right) + u3_{ja}\left(N_j(t)\right) - C_{ja} \qquad (1)$$

where $U_{ja}(t)$ is the total utility that an application user a gets from adopting the service platform j at a given time t. It is the sum of all positive benefits minus the respective cost. $u_{1ja}(Q_j(t))$ represents the user's utility from the quality of service Q_j offered at time t, which is the functional benefit of the service. $u_{2ja}(S_j(t))$ denotes the user's utility from the number of services S_j that are available to the users of the service platform at time t. It determines the user's value from adopting a service platform of a certain level of service availability. $u_{3ja}(N_j(t))$ is the utility of the user generated from the level of installed base of users on the service platform j. It represents the additional benefits obtained from the number of users of the platform service. Each utility is normalized between [0,1], indicating the level. The value 1 means that the maximum level has been reached, while a value of 0 represents the lowest level. C_{ja} specifies the application usage cost a user faces for using one or more services. The net utility that a customer gets from adopting the platform service is obtained by deducting this total cost from the benefits.

Service Developer Value: Considering the overall structure of the value creation model, the value of a service developer U_{js} can be detailed as follows:

$$U_{js}(t) = u_{js}\left(Q_j(t)\right) + RS_{js} * C_{ja} * \frac{N_j(t)}{S_j(t)} - C_{js} \qquad (2)$$

where $U_{js}(t)$ is the total value that a service developer *s* gets from adopting the service platform *j* at a given time *t*. A service developer's revenue comes from the average fee a user pays for a service C_{ja} multiplied with the fraction of the number of users $N_j(t)$, who are using service *s*. In this model, the fraction of the number of users of the platform is calculated as the total number of users $N_j(t)$ divided by the number of services $S_j(t)$. It represents the average number of users per service. The total revenue obtained is reduced by the revenue share RS_{js} that the platform provider gets. The cost types are either fixed subscription fees or variable usage costs that have to be paid to the platform service provider.

Service Platform Provider Value: In our value creation model, the value of the service platform provider U_{jp} is defined as:

$$\mathrm{U_{jp}(t) = C_{js} * S_j(t) + \left(1 - RS_{js}\right) * C_{ja} * N_j(t) - C_{jpa}\left(N_j(t)\right) - C_{jps}\left(S_j(t)\right)} \qquad (3)$$

where $U_{jp}(t)$ is the value (profit) of a platform provider *p* from offering service platform *j* at a given time *t*. The profit is calculated as the difference between the revenue that the platform generates from all service developers, $C_{js}* S_j(t)$, and all application users (i.e., the revenue that is shared with the service developer, (equation 2)) and the cost of supporting users C_{jpa} and maintaining services C_{jps}. Service platforms provide maintenance, data storage, and security to the application services they host. It constitutes their cost for services and users, which increases as the number of services $(S_j(t)$ and users $(N_j(t)$ increases.

3. Simulation

3.1. Value Creation Dynamics

The simulation model used here (Figure 4) helps evaluating the dynamics of the value creation. The values, which are created by the service platform for the three stakeholders in a certain time period, are based on equations 1, 2, and 3.

As illustrated in Figure 4, the service variety increases by a certain number of new services in every time period. A service developer, who subscribes to the service platform, requires a development environment to offer an application service. The number of the new services or service developers is denoted by $s_j(t)$.The installed base increases by a certain number of new adopters in every time period. This number of new adopters is represented by $n_j(t)$. Note, we do not consider an outflow of customers here. Consequently, the installed base $N_j(t)$ and the number of services $S_j(t)$ are cumulative values increased though new adoptions over time.

Interactions between the stakeholders occur through the value-determining parameters (Figure 4). The QoS offered to the service developers and application users is positively affected by the utility of the platform provider. The higher the platform provider's utility, the more the incentive of the platform provider to improve its services to meet the requirements and expectations of its customers. This, in turn, attracts more customers, increasing the platform's value. The number of service developers is positively impacted by the utility of existing service developers, as a high utility motivates more developers to join. The number of application users increases as more services are offered and QoS is improved. This increase in the number of users motivates more users to join the platform and positively impacts the value of the platform provider and the service developers.

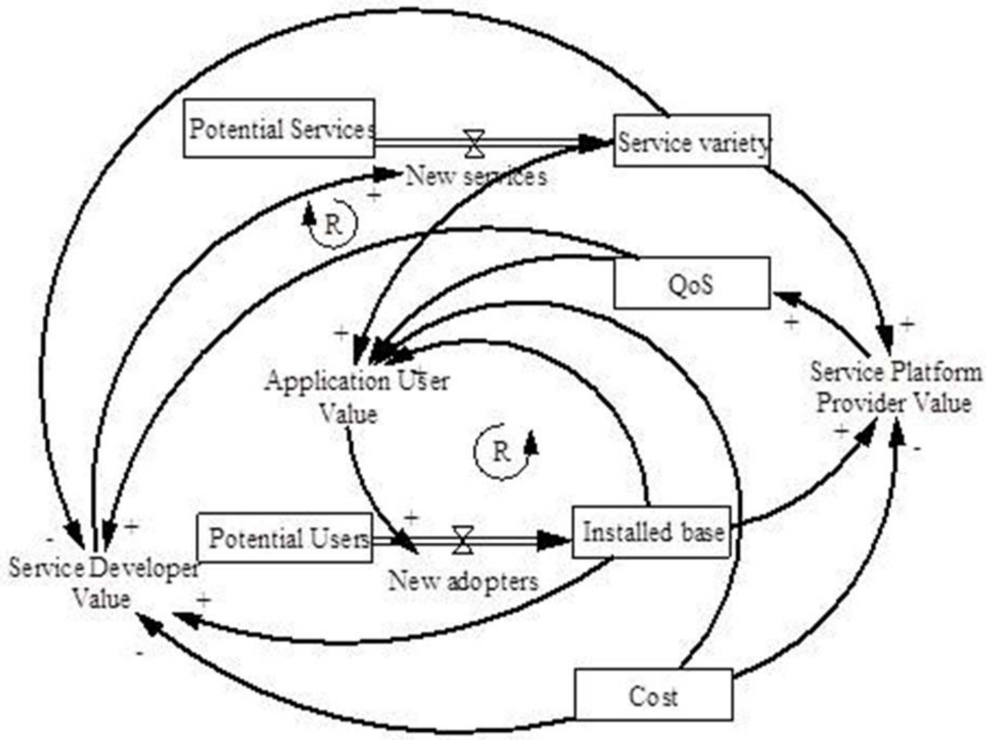


Figure 4. A model of stakeholder value dynamics with feedback loops.

In an effort to improve the actual value created, platform providers can make business decisions to improve the QoS offered and to reduce the cost incurred through deploying a better infrastructure. Service developers make choices about joining a platform or develop more services to increase the number of services offered. They also make similar decisions as the platform service providers with respect to cost and QoS. Application users simply decide on adopting a platform and using a certain number of services.

3.2. Settings and Assumptions

For the implementation of the simulation, we use Vensim system dynamics software. The simulation duration was set to 47 months to see the dynamics over a longer period of time and to model the development of Apple iTunes since its launch in July 2008 [29].

The service scenario used here to observe the behavior of the value of stakeholders is based on real situations and practices observed in the market. The scenario considers one provider, 650000 service developers and 400 million application service users. The cost of offering services C_{js}, which incurred by service developers and is mainly due to development and hosting fees to service platform providers, varies based on the size of the application, the number of users supported, storage capacity, and the amount of back-end processing required. Monthly cost of offering services C_{js} is set to \$2, monthly cost of use for application users C_{ja} is set to be \$0.05, the cost of support for users C_{jap} as \$0.01 per application user and the cost of support for services C_{jsp} to be \$0.1 per service [29], [30], [31], [32].

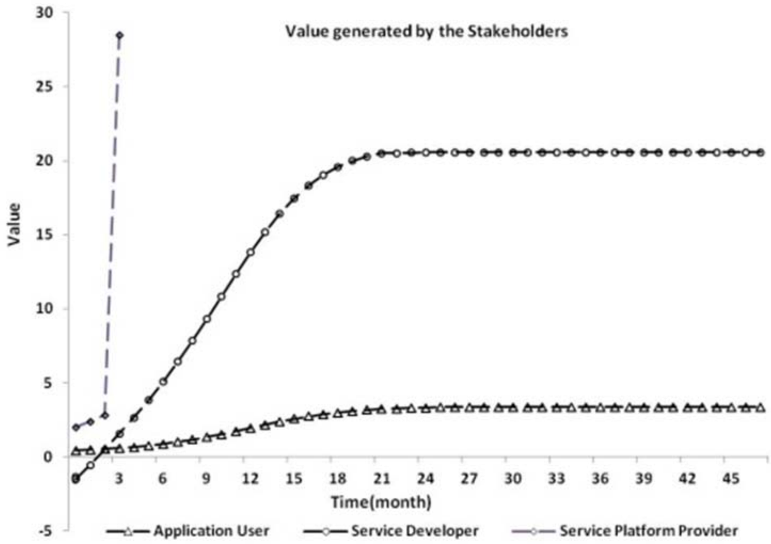
The value of $Q_j(t)$ is considered to be an indicator of the level of QoS offered and represented by a range [0,1]. The value 1 represents the highest value. In our scenario, $Q_j(t)$ was modeled to dynamically show a slight increase as the utility of the platform provider increases. It indicates that the growth of the platform results also in additional functionality and performance, benefiting the customers. Revenue share of the platform provider $(1 - RS_{js})$ is set to be 30% and the revenue share of service developers RS_{js} is consequently 70% of the total revenue obtained from application users. Those are settings that are practiced by major service platforms (e.g., Apple iTunes and Google Apps Marketplace [29], [30], [32]).

Regarding the behavior of stakeholders and the market environment, it is assumed that an application user subscribes to one or more services at a time and a service developer supplies one service. Even in cases where the application users and service developers are using free services, they generate a certain value for the providers; therefore in order to simplify the model, all customers are considered paying for the services they consume. This means that they either pay a monthly service fee or with advertisement placement on their services.

With respect to the adoption of users, it is assumed that, if the value of application users $U_{ja}(t)$ remains greater than 0, a certain number of new users $n_j(t)$ decides to join the installed base $N_j(t)$ until the point of market saturation. In this model, market saturation occurs when $N_j(t)=1$. Applying the same principles to service variety $S_j(t)$ and assuming that the value of the service developers $U_{js}(t)$ is positive, new services $s_j(t)$ will also join the platform. In our experiment, the number of new users $n_j(t)$ and the number of new services $s_j(t)$ can also be variable in each time period. In this case, the adoption rate of users per month increases (decreases) as the value of the existing users increases (decreases). To calculate the actual number of new users, the adoption rate is multiplied by the number of potential users (i.e., users that have not adopted the platform yet). In the same way, the actual number of new services can be calculated. As the next sections shows, this adoption scheme is simulated for cases of high and low two-sided network effects. The constant adoption scheme represents low variations over time (i.e., a low network effect of installed base and services on adoption). The dynamic rate of adoption increases along with the installed base and services and, therefore, represents a high network effect.

3.3. Results

In case of a high two-sided network effect (Figure 5), there is a large increase in the stakeholder values. The installed base grows faster due to faster changes in all of the three values $U_{ja}(t)$,$U_{js}(t)$, and $U_{jp}(t)$. In case of low two-sided network effects (Figure 6), the value of stakeholders are mainly generated from the level of QoS ($Q_j(t)$). Thus, the change in value remains low.



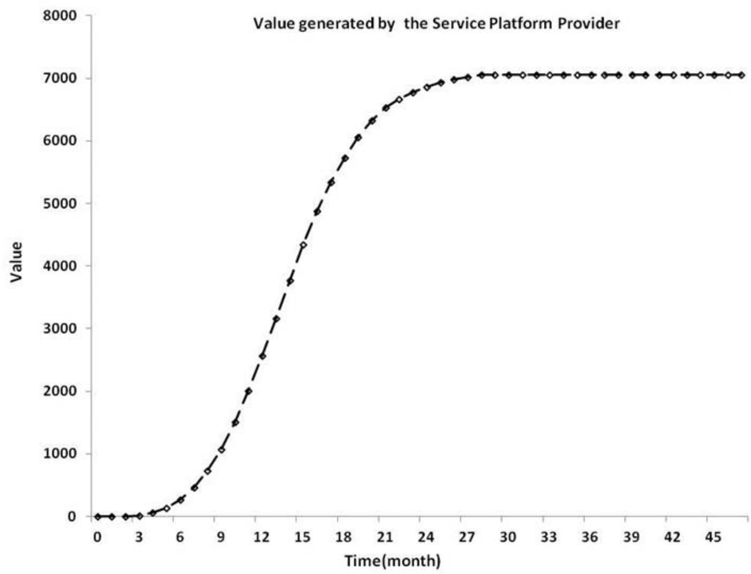
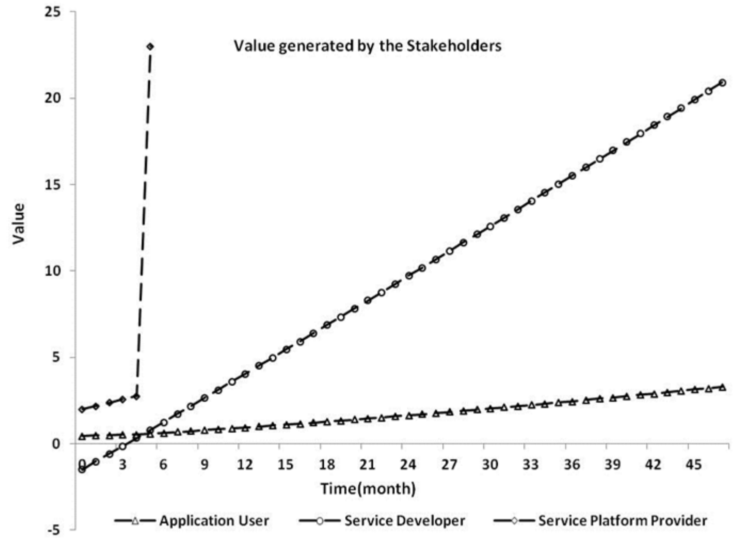


Figure 5. Dynamics of value generated by the stakeholders in cases of a high network effect.



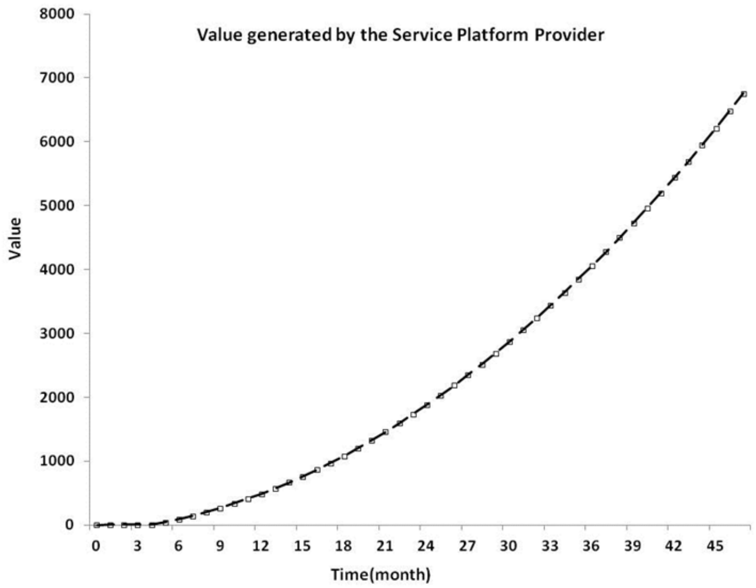


Figure 6. Dynamics of value generated by the stakeholders in cases of a low network effect.

The two cases are used to show the level of dependence of growth of the service platform on the value of the application users $U_{ja}(t)$, service developers value $U_{js}(t)$, and the value of the platform provider $U_{jp}(t)$. If the level of QoS $Q_j(t)$ and the cost of usage C_{ja} and C_{js} are assumed to be fixed, the difference in the value of application users, the value of service developers, and value of platform providers is caused by the level of installed base $N_j(t)$ and the level of service variety $S_j(t)$ only.

Looking at the application user values of Figure 5 and Figure 6, application users subscribe to a service, which performs a certain task, from their service developers at the beginning of period $t=0$, which outweighs their user cost C_{ja}. This value that the user obtains at the time of joining the platform is indicated by $Q_j(t)$ in equation 1.

Consequently, they receive a value $U_{ja}(t) > 0$ at period $t=0$. Maintaining a positive utility of application users is a condition, which has to be fulfilled in order to successfully launch any application service or a service platform.

Service developers also need to subscribe to a service platform and utilize its offerings to build their services (equation 2). However, the values of service developers show a different behavior in the beginning. This is because their initial cost is higher than the cost faced by application users. They cannot recover their costs of offering C_{js} until they acquire a sufficiently large number of customers and generate revenues. Therefore, they take more time until they receive a value $U_{js}(t) > 0$, as it is shown in Figure 5 and 6, at the time period $t=3$.

Figures 5 and 6 show that, unlike service developers and application service users, which share a common behavior as customers of platform providers, platform providers behave as service providers only. Consequently, their value received $U_{jp}(t)$ at the beginning of the period $t=0$ remains 0 until they start obtaining customers and generate revenue through development kits and hosting fee from service developers C_{js} and application usage fee from application users C_{ja}. The only cost that has to be covered are the cost of supporting application users C_{jap} and the cost of managing services C_{jsp}.

The value of service platform providers $U_{jp}(t)$ grows faster than the value of service developers $U_{js}(t)$ and application users $U_{ja}(t)$, as the size of both stakeholder groups grows (Figure 5 and Figure 6). The platform provider obtains benefit from both sides of the market. The value of application users shows a slow growth compared to the other two stakeholders, since they benefit the least from the growing number of customers. However, the value of the service developers is only slightly larger than the value of the application service user.

All stakeholder values are interdependent and changes in one of them affect the values of the other stakeholders. An evaluation of the relative impact of all value parameters indicates that the installed base $N_j(t)$ is a common positive determinant of value for all stakeholders. Although the value of the application users is important as the basis for value creation, a sufficiently large value obtained by service developers is necessary to sustain the service platform market. Currently, the value of service developers is quite low, having the risk of developers withdrawing from the service platform.

The implications of these results to the service platform market and to the stakeholders considered in this study is that both service developers and service platform providers need to focus on finding a way of sharing the value such that it allows developers to sustain their services over a longer time period. Otherwise, as the number of services still increases in the real world, the average return on developing an application service will reduce even further and, therefore, increase the risk of developers withdrawing from the market, causing a market failure.

4. Conclusions

This paper has presented a value creation model for stakeholders of an IT service platform, using additive value functions. The model can be used as a tool for evaluating values created for application users, service developers and platform providers. It allowed the integration of value-determining parameters to calculate the value (i.e., utility, profit) of stakeholders. Quality of service, service variety, installed base, and user cost are the parameters considered. The value creation model was evaluated using simulation software, in order to examine the value creation dynamics.

The simulation results indicate that the installed base of application users benefits all stakeholders and the service platform provider benefits largely from the two-side network effect. As a strategy for platform providers, it is not only important to focus on building the network of application users but also to maintain attractive returns for developers. This is important for sustaining the value of all stakeholders and growth of the service platform.

Our future studies may explore additions to the model by incorporating more factors such as pricing policies and market structures. We could investigate how the competition between multiple IT service platform providers impacts the values of platform providers and service developers.

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