Measuring the Mobile Phone Video Service Utility Based on a Service Value Network Model

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ABSTRACT

Service value networks (SVNs) are a new form of industrial cooperation. Within SVNs, service providers engage in loosely coupled relationships to jointly offer dynamically configured complex services to customers. Value is co-created through these joint complex services. By specialization, service providers leverage the knowledge and capital assets of their partners, and share the risk of operating in a changing and uncertain environment. However, as a new approach, SVNs lack theoretical foundations and empirical studies to validate its applicability. This paper seeks to address these problems by making three contributions. First, based on an existing theoretical SVN model, the paper presents a design for a mobile phone video service value network (MPVSVN) in China. Second, we describe a systematic approach to calculate the value and utility of services on the SVN. Third, we demonstrate our approach in detailed steps through real world service examples identified from the MPVSVN.

Keywords

Service value networks (SVNs), mobile phone video services (MPVSs), complex services, service value, service utility.

INTRODUCTION

According to 2012 Internet Trends published by KPCB (Meeker and Wu, 2012), there were one billion smartphone subscribers in the world in 2012, representing a 20% of the entire population of the mobile phone users. In the same year, the smartphone shipment to China amounted for 26.5% of the total global shipment, making China the biggest smartphone market in the world. It was predicted that by the end of 2013, the population of the smartphone users in China would grow beyond 500 million (Llamas, Stofega, Drake, Crook, and Hoffman, 2012). The rapidly growing mobile phone market has opened up many business opportunities for service providers; yet, at the same time, as more and more people are using smartphones, service providers are also facing rising demands and tough competitions for sophisticated, customized products. In such a dynamic market, traditional vertical supply chains can no longer meet the ever-changing demands of the customers and service providers now seek new forms of cooperation. One cooperation form is called "*service value networks (SVNs)*" (Blau, Kramer, Conte, and Dinther, 2009). In such networks, service providers engage in loosely coupled relationships to offer dynamically configured joint complex services to customers. Through specialization, service providers leverage the knowledge and capital assets of their partners, and lower the risk of operating in a changing and uncertain environment (Blau, Kramer, Conte, and Dinther, 2009).

Driven by large companies such as IBM and SAP (Basole and Rouse, 2008), SVNs are a promising cooperation approach and represent the current trend in the service industry. However, as a new approach, SVNs lack theoretical foundations and empirical studies to validate its applicability. To our knowledge the most complete formalization of SVNs to date is given by Blau, Kramer, Conte, and Dinther (2009), and Blau, Weinhardt, Dinther, Conte, and Xu (2009). These authors developed a formal model of SVNs and provided a precise definition to characterize what SVNs are and what constitutes complex services on SVNs. However, their work is purely theoretical and has not been validated by empirical studies. This paper seeks to address these problems by making three contributions:

- First, we design a SVN for *mobile phone video services (MPVSs)* in China. The purpose of this design is to demonstrate the practical applicability of Blau et al's SVN model.
- Second, we provide a service utility function and based on this function we formulate a systematic approach to calculate the value and utility of services on the SVN.
- Third, we demonstrate our approach in detail through real world service examples identified from the *mobile phone video service value network (MPVSVN).*

This paper proceeds as follows. Section 2 first defines SVNs and their related concepts, and then introduces a service utility function. Section 3 then applies the SVN model to the design of the MPVSVN in China. Based on the utility function defined in Section 2, Section 4 describes and illustrates a systematic method for calculating service utility. Section 5 discusses some closely related work and finally, Section 6 concludes the paper.

DEFINITION

Service Value Networks

Value and value creation are at the heart of the service industry. In the service market, value is co-created as well as co-determined by *service value networks* (SVNs). Blau, Kramer, Conte, and Dinther (2009) defined a SVN as consisting of a set of *service providers* ($s \in S$) that supply a portfolio of *service offers* ($v \in V$) that provide described functionality. Each service provider can own one or more service offers indicated by an *ownership relation.* Services and their connections form a graph-like structure that is directed and acyclic starting from a source node v_s and ending at a sink node v_f . For convenience the terms *service offer* and *service* can be used interchangeably (Blau, Weinhardt, Dinther, Conte, and Xu, 2009).

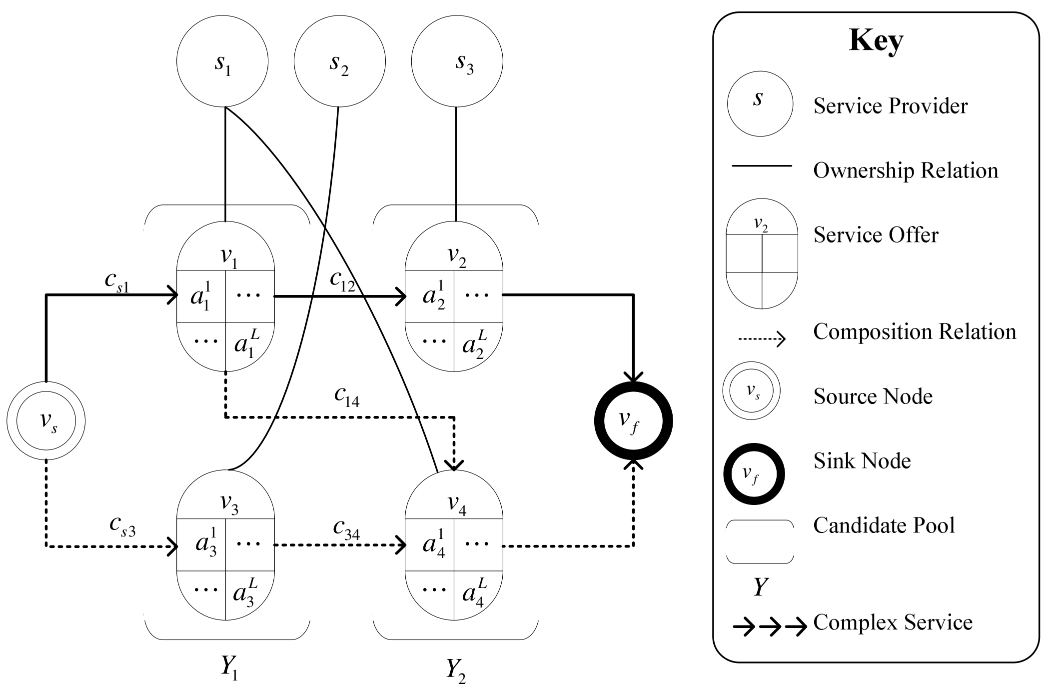

Figure 1. An Abstract Service Value Network Model (Blau, Weinhardt, Dinther, Conte, and Xu, 2009)

Figure 1 shows an abstract model of SVN with four service offers $V = \{v_1, v_2, v_3, v_4\}$ that are owned by three service providers $S = \{s_1, s_2, s_3\}$. *Substitutable services* are those providing roughly similar functionality and are clustered in *candidate pools* ($y \in Y$). A candidate pool is a set of potential services $Y_1 = \{v_1, v_3\}$ that can be replaced on-demand.

Interoperable services are those having compatible interfaces and input and output capabilities, and such service offers form a directed *composition relation*. According to Figure 1, there are three pairs of interoperable service offers: (v_1, v_2), (v_1, v_4), and (v_3, v_4).

Service Value, Complex Services and Service Configuration

Service value is created through the SVN by performing a sequence of services that form a connected path from source to sink. Such created value is called a *complex service* (Blau, Weinhardt, Dinther, Conte, and Xu, 2009). Let *F* denote the set of all feasible paths from source to sink. Every $f \in F$ represents a possible instantiation of the complex service consisting of functionality from each candidate pool. In Figure 1, a complex service can be instantiated either by a composition of v_1 and v_2, or v_1 and v_4, or v_3 and v_4.

Services are characterized by their *attributes* (Blau, Weinhardt, Dinther, Conte, and Xu, 2009). Service attributes can be either *functional* or *non-functional* (e.g. availability, price or security). Non-functional attributes are also called "*quality of service (QoS) requirements*" (Sun, Zhao, Loucopoulos, and Zhou, 2013). Service providers can configure each service according to its attributes. A *service configuration* A_i of service $i \in V$ is fully characterized by a vector of attributes $A_i = (a_i^1, a_i^2, ..., a_i^L)$ where a_i^l is an *attribute value* of attribute $l \in L$ of service i's configuration. The configuration of a service represents the quality level provided by the service and differentiates its offering from other services.

The configuration A of the complex service is the aggregation of all attribute values of contributing services on the path f such that $A_f = (A_f^1, A_f^2, ..., A_f^L)$ with $A_f^l = \oplus a_f^l$ (Blau, Weinhardt, Dinther, Conte, and Xu, 2009). The aggregation operator of attributes values depends on their type (i.e. encryption can be aggregated by an AND operator whereas response time is aggregated by a sum operator).

These concepts will be used in the following section when we introduce a utility function for calculating the service utility.

Service Utility function

We define *service utility* $U(A_f)$ as the overall weighted value of a configuration A_f of the complex service represented by path f . $U(A_f)$ is calculated by a utility function as in Formula (1).

$$U(A_f) = \sum_{i=1}^{n} \mu_i U_i(f) \qquad (1)$$

Where μ_i is the weight of complex service i on service path f and $\sum_{i=1}^{n} \mu_i = 1$.

$U_i(f)$ represents the utility value of complex service i on path f. Supposing service i has L_i attributes, $U_i(f)$ is measured by the weighted average of the values of all attributes of service i, as shown in Formula (2).

$$U_i(f) = \sum_{l=1}^{L_i} w_l a_i^l(f),\ i \in f \qquad (2)$$

Where $a_i^l(f)$ represents the l^{th} attribute value of each individual service on path f and w_l is the weight for attribute $a_i^l(f)$. $w = (w_1, w_2, ..., w_{L_i})$ is the weight vector of different attributes in complex service i and $\sum_{l==1}^{L_i} w_l = 1,\ i \in f$.

In the following sections, we first produce a design for the MPVSVN in China and then describe a method that uses Formulae (1) and (2) to calculate the utility of complex services for MPVSs in China.

DESIGNING A MOBILE PHONE VIDEO SERVICE VALUE NETWORK MODEL

Based on the SVN model described in Section 1, this section produces a design of a MPVSVN model for service providers in China. According to our market research, currently the MPVS providers in China are made of the five major groupings:

- *Handset providers* that consist of Apple, SAMSUNG, HTC, NOKIA, MIUI, etc.
- *Operating system (OS) platform providers* consisting of Apple, Nokia and Microsoft.
- *Mobile network providers* including China Mobile, China Unicom, and China Telecom.
- *Mobile phone video content aggregation providers* including YOUKU &TUDOU, LESHI, iQIYI and so on.
- *Mobile phone video content providers* including end-users and media organizations, such as CCTV and Zhongying film producer, etc.

The MPVSVN in China consists of these service providers and their service offers. Based on the structure and components in the SVN model (Figure 1), we have developed a MPVSVN model in China, as Figure 2 shows.

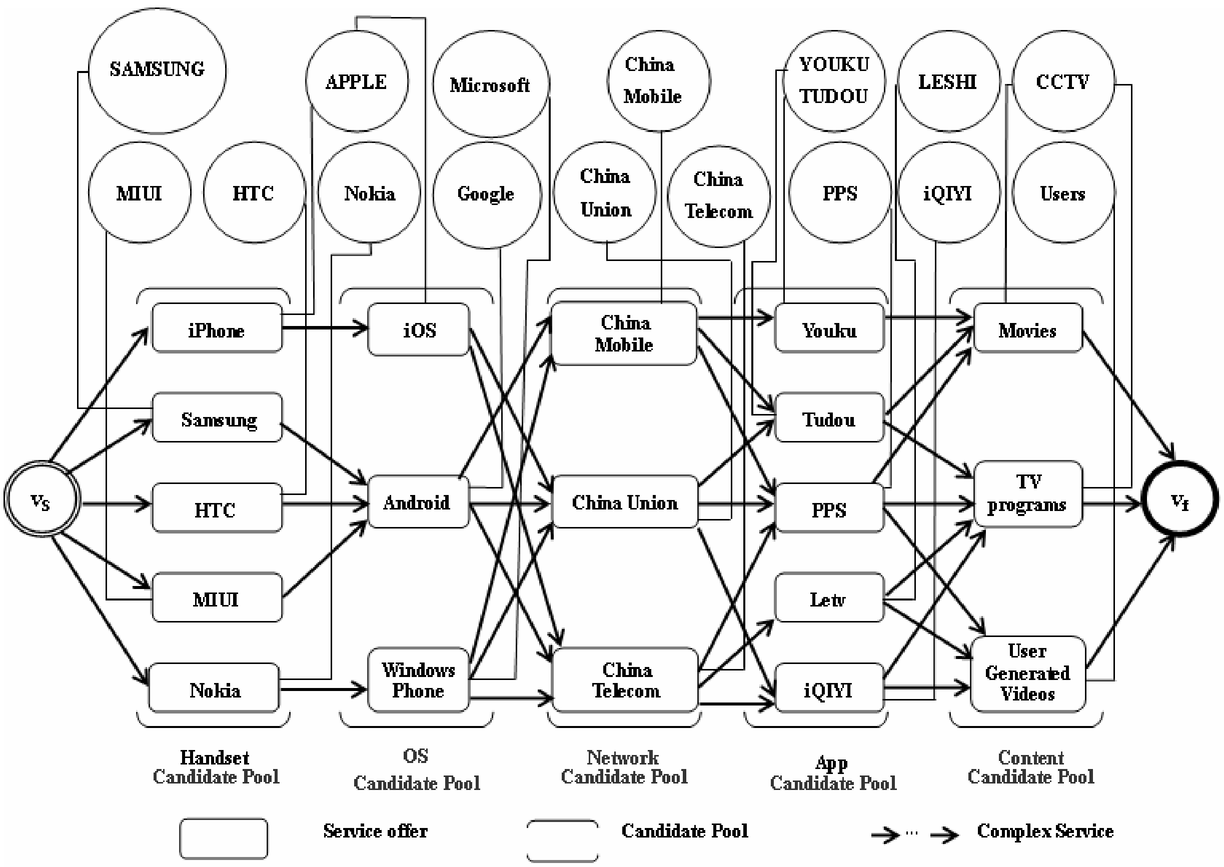

Figure 2. The Mobile Phone Video Service Value Network (MPVSVN) in China

According to Figure 2, the MPVSVN has five candidate pools, consisting of *Handsets, OS, Networks, Applications* and *Content*. Each candidate pool has a set of substitutable service offers. For example, the Handset pool contains iPhone, Samsung, HTC, MIUI, and Nokia. Based on the number of candidate pools and the number of service offers shown in Figure 2, the maximum number of potential composition paths could be 5x3x3x5x3 = 676. Examples of paths are iPhone → iOS → China Union → Letv → TV Programs and HTC → Android → China Mobile → PPS → User Generated Videos. Since each service can be configured into different configurations, the number of potential complex services can be infinite. The MPVSVN therefore can offer the service consumers an infinite number of configurable services.

In the following section, we show how to calculate the overall utility of complex services on the MPVSVN.

A MULTI-OBJECTIVE OPTIMIZATION APPROACH TO MEASURING SERVICE VALUE AND UTILITY

Based on Formulae (1) and (2), we have formulated a systematic approach to measuring the service utility of the MPVSs. This approach consists of four major steps and their associated methods, summarized in Table 1.

Step 1: Determining the attributes and attribute values.

Step 2: Calculating the weights for all the attributes.

- **Step 2.1:** Constructing the standardized objective attribute matrix.
- **Step 2.2:** Constructing the customer preference matrix.
- **Step 2.3:** Calculating the weights by aggregating objective attribute values and costumer preference values.
- **Step 2.4:** Calculating the subjective weights through expert scoring.
- **Step 2.5:** Aggregating the objective and subjective weights.

Step 3: Calculating the service values.

Step 4: Calculating the overall utility for the complex service.

Table 1. A Systematic Approach to Calculating the Overall Utility of A Complex Service

Since the method presented in Table 1 is general, for brevity, the following sections only show how to calculate the value for services in the handset and OS pools. In our calculation, we have combined the value of services in the handset and OS pools together because every handset must have an OS as a minimum complex service.

Step 1: Determining the Attributes and Attribute Values

The purpose of this step is to identify the attributes for all the service offers in each candidate pool and assign a numerical value to each attribute. For brevity, here we only consider attributes for the Handset and OS pool in the MPVSVN, which has five substitutable service offers, which are iPhone 4S, Samsung Galaxy, HTC VT, MIUI 1S, and Nokia Lumia. Our market research informed us that the most important attributes that concern the service consumers for handset and OS are *Price, Market Share of OS, Screen Size, Resolution Ratio, RAM, ROM,* and *Battery Capacity*. For each of these attributes, we calculated its average market value. Table 2 summarizes the set of attributes for the handset and OS candidate pool and their values.

Attribute / Phone	Price **(RMB)**	Market Share of OS (%)	Screen Size **(inch)**	Resolution **(Pixel)**	RAM **(MB)**	ROM **(GB)**	Battery **(mAh)**
iPhone 4S	4488	21	3.5	614400	512	16	1420
Samsung Galaxy	4699	60	4.8	921600	1024	4	2100
HTC VT	1999	60	4	384000	512	4	1650
MIUI 1S	1619	60	4	409920	1024	4	1930
Nokia Lumia	2499	5	3.7	384000	512	16	1450

Table 2. The Identified Attributes and Attribute Values for the Handset and OS Candidate Pools

Step 2: Calculating the Weights for all the Attributes

The weight of an attribute determines the degree of the importance of the attribute. The purpose of this step is to construct the weight vector $w=(w_1,w_2,...,w_{L_i})$ based on three sets of values: (1) the values from the standardized objective attribute value matrix, (2) the values from the consumer preference matrix and (3) the subjective values from the expert score vectors. Once the weighting vector $w=(w_1,w_2,...,w_{L_i})$ is calculated, the value of complex service x_i is determined by Formula (3).

$$Z_i(w)=\sum_{l=1}^{L} w_l r_i^l \, , i=1,2,\cdots,m \qquad (3)$$

Where r_i^l is the *Standardized attribute value* of attribute $l \in L$ of service i's configuration.

We apply a multi-attribute decision method to find the optimal weight vector $w=(w_1,w_2,...,w_{L_i})$, and calculate the value of each service. The values of all the services are converted into a complementary judgment matrix by a linear conversion function, which is described in Formula (5). The rational weight vector $w=(w_1,w_2,...,w_L)$ should minimize the deviation between the converted complementary judgment matrix and the consumer preference complementary judgment matrix. Taking the minimum deviation as the goal, the optimization model is established in Formula (7).

The following sub-steps describe how to construct this weight vector.

Step 2.1: Constructing the Standardized Objective Attribute Matrix

Assuming there are m substitutable services in a candidate pool, denoted by $x_i, i=1,2,...,m$, for service x_i, its l^{th} attribute value is denoted by $a_i^l, i=1,2,...,m, l=1,2,...,L$. All the attribute values of these substitutable services are stored in a matrix $A=\left(a_i^l\right)_{m\times L}$.

The values for the seven attributes in the Handset and OS pools are given in the following matrix.

$$A=\begin{pmatrix} 4488 & 21 & 3.5 & 614400 & 512 & 16 & 1420 \\ 4699 & 60 & 4.8 & 921600 & 1024 & 4 & 2100 \\ 1999 & 60 & 4 & 384000 & 512 & 4 & 1650 \\ 1619 & 60 & 4 & 409920 & 1024 & 4 & 1930 \\ 2499 & 5 & 3.7 & 384000 & 512 & 16 & 1450 \end{pmatrix}$$

Attribute value matrix A contains rare values. To obtain an objective measure of these values, we apply a normalization function as shown in Formula (4) to normalize them.

$$\mathrm{r}_i^l=\begin{cases} \dfrac{a_i^l}{\max\limits_i(a_i^l)}, l\in L_1 \\ \dfrac{\min\limits_i(a_i^l)}{a_i^l}, l\in L_2 \end{cases} \qquad (4)$$

Where L_1 represents the benefit attributes and L_2 represents the cost attributes. Formula (3) normalizes the attribute values by maximizing the values of the benefit attributes and minimizing the values of the cost attributes.

In the Handsets and OS pool, there is only one cost attribute, which is Price; the rest are the benefit attributes. Based on Formula (3), we have constructed the following normalization matrix for all the attributes in the Handsets and OS pool.

$$R=\begin{pmatrix} 0.3607 & 0.3500 & 0.7292 & 0.6667 & 0.5000 & 1.0000 & 0.6762 \\ 0.3445 & 1.0000 & 1.0000 & 1.0000 & 1.0000 & 0.2500 & 1.0000 \\ 0.8099 & 1.0000 & 0.8333 & 0.4167 & 0.5000 & 0.2500 & 0.7857 \\ 1.0000 & 1.0000 & 0.8333 & 0.4448 & 1.0000 & 0.2500 & 0.9190 \\ 0.6479 & 0.0833 & 0.7708 & 0.4167 & 0.5000 & 1.0000 & 0.6905 \end{pmatrix}$$

Using Formula (3), The values of the services are transformed into a complementary judgment matrix $B' = (b_{ij}^{'})_{n\times n}$ by the following linear conversion function:

$$b_{ij}^{'} = \frac{1}{2}(1 + z_i(w) - z_j(w))$$

$$= \frac{1}{2}(1 + \sum_{l=1}^{L} w_l r_i^l - \sum_{l=1}^{L} w_l r_j^l)$$

$$= \frac{1}{2}(1 + \sum_{l=1}^{L} w_l (r_i^l - r_j^l)) \qquad (5)$$

$$b_{ij}^{'} + b_{ji}^{'} = 1 \,, b_{ii}^{'} = 0.5 \,, b_{ij}^{'} \geq 0, i, j = \{1, 2, ..., m\}.$$

Step 2.2: Constructing The Customer Preference Matrix

Customer preference is also an important factor that influences the value of service. To obtain customer preference data, we conducted an online survey by asking customers about their preference to different handset and OS. From the responses we selected 38 valid answers. We processed these answers by using a pair-wise comparison on the complementary scale of 0.1 to 0.9 and represented the results in a complementary judgment matrix $B = \left(b_{ij}\right)_{m\times m}$, where b_{ij} represent the relative important degree of service offer x_i comparing to service offer x_j, where $b_{ij} + b_{ji} = 1$, $b_{ii=0.5}$, $b_{ij} \geq 0,\ i, j = 1, 2, ..., m$. The complementary judgment matrix for the attribute values in the handset and OS pools is given below.

$$B=\begin{pmatrix} 0.5000 & 0.5974 & 0.6256 & 0.6590 & 0.6795 \\ 0.4026 & 0.5000 & 0.5744 & 0.5744 & 0.6077 \\ 0.3744 & 0.4256 & 0.5000 & 0.5564 & 0.5667 \\ 0.3410 & 0.4026 & 0.4436 & 0.5000 & 0.5359 \\ 0.3205 & 0.3923 & 0.4333 & 0.4641 & 0.5000 \end{pmatrix}$$

Step 2.3: Calculating the Weights by Aggregating Objective Attribute Values and Costumer Preference Values

The purpose of this step is to calculate the values of the weight vector $w = (w_1, w_2, ..., w_{L_i})$ based on the values from the standardized objective attribute matrix and the customer preference matrix obtained from Steps 2.1 and 2.2.

We use a linear deviation function to calculate the deviation between two complementary judgment matrices $B = (b_{ij})_{m\times m}$ and $B' = (b_{ij}^{'})_{m\times m}$, as in Formula (6):

$$f_{ij} = b_{ij} - b_{ij}^{'} = b_{ij} - \frac{1}{2}(1 + \sum_{l=1}^{L} w_l (r_i^l - r_j^l))$$

$$= \frac{1}{2}((2b_{ij} - 1) - \sum_{l=1}^{L} w_l (r_i^l - r_j^l)), i, j \in N \quad (6)$$

In order to get a reasonable weight vector, the smaller deviation is always better. In doing so, we establish the optimization function to minimize the derivation value, as shown in Formula (7):

$$\min \text{G} = \sum_{i=1}^{m} \sum_{j=1}^{m} f_{ij}^2 = \frac{1}{4} \sum_{i=1}^{m} \sum_{j=1}^{m} [(2b_{ij} - 1) - \sum_{l=1}^{L} w_l (r_i^l - r_j^l)]^2$$

$$\text{s.t.} \sum_{l=1}^{L} w_l = 1, w_l \geq 0, l = 1, 2, ..., L \quad (7)$$

Step 2.4: Calculating the Subjective Weights through Expert Scoring

In this step, we construct an expert score vectors for the attributes. Assuming that there are q experts $h = (h_1, h_2, ..., h_q)$ involved in scoring and each expert produces a score vector w, the scores given by the k^{th} expert to the weight vector are denoted as $w_k^0 = (w_{k1}^0, w_{k2}^0, ..., w_{kL}^0)$, $\sum_{j=1}^{L} w_{kj}^0 = 1$, $k = 1, 2, ..., q$.

To aggregate the scores given by q experts $h = (h_1, h_2, ..., h_q)$, we apply the optimization model as represented in Formula (8):

$$\min \text{G'} = \sum_{k=1}^{q} \sum_{l=1}^{\text{L}} h_k (w_l - w_{kl}^0)^2$$

$$\text{s.t.} \quad \sum_{l=1}^{L} w_l = 1, w_l \geq 0, l = 1, 2, ..., L \quad (8)$$

Formula (8) has two purposes: First it aims at minimizing the sum of the distances form the total weight value W to every expert's weight $w_k^0 = (w_{k1}^0, w_{k2}^0, ...w_{kL}^0)$, $k = 1, 2, ..., q$. Second, it aims at minimizing the sum of the squares of the total deviation between every weight and the weight $w_{kl}^0 (k = 1, 2, ..., q; l = 1, 2, ..., L)$.

For our study we have invited 10 experts to score the attributes, but the space limitation prevents us from presenting the expert scores here.

Step 2.5: Aggregating the Objective and Subjective Weights

This step aggregates both objective and subjective weights to find the optimized attribute weights for the weight vector $w = (w_1, w_2, ..., w_{L_i})$. The aggregation is performed by an optimization model, as shown in Formula (9).

$$\min \quad \text{d}_1^+ + \text{d}_1^- + \text{d}_2^+ + \text{d}_2^-$$

$$\text{s.t.} \frac{1}{4} \sum_{i=1}^{m} \sum_{j=1}^{m} [(2b_{ij} - 1) - \sum_{l=1}^{L} w_l (r_i^l - r_j^l)]^2 - d_1^+ + d_1^- = f_1^0$$

$$\sum_{k=1}^{q} \sum_{l=1}^{L} h_l (w_l - w_{kl}^0)^2 - d_2^+ + d_2^- = f_2^0$$

$$d_i^+, d_i^- \geq 0 \quad (9)$$

Where f_1^0 is the optimal function value of Formula (7), and f_2^0 is the optimal function value of model (8).

As an example, to find the respective values of objective functions f_1^0 and f_2^0, we first use the standardized attribute value matrix R and customer preference matrix B to solve the equation represented in Formula (7), and then use the expert 's weight vectors w_k^0 to solve the equation in Formula (8). Finally we apply f_1^0 and f_2^0 to the optimization model (Formula (9)) to obtain the attribute weight vector of the services in the Handset and OS candidate pools:

w = (0.1258, 0.1180, 0.1191, 0.2463, 0.0536, 0.2412, 0.0960).

Step 3: Calculating the Service Values

Based on the weighted attribute values obtained in Step 2.4, the value of service x_i can be obtained by Formula (3).

The values for the five services in the Handset and OS candidate pool are stored in vector z :

$$z = (z_1, z_2, z_3, z_4, z_5) = (0.6706, 0.7366, 0.5843, 0.6547, 0.6201)$$

Where z_1, z_2, z_3, z_4, z_5 denote the service values for iPhone, Samsung, HTC, MIUI, and Nokia respectively.

By repeating Steps 1-3, we can work out the weighted attribute values for the Network candidate pool. The substitutable services in this pool are China Mobile, China Union and China Telecom (Figure 2). These services are characterized by four attributes, which are the Number of 3G Subscribers, Downlink Speed, Video Costs, and Base Stations. The weighted attribute values for the Network pool:

w =(0.3157,0.0178,0.2848,0.3277).

The values for the three services in the Network pool are:

$$z' = (z_1', z_2', z_3') = (0.8724,\ 0.9551,\ 0.6073)$$

Where z_1', z_2', z_3' denote the service values for China Mobile, China Union and China Telecom respectively.

To calculate the weighted attribute values for the App and Content candidate pools, we used the Customer Satisfaction Index (CSI) to indicate the combined service values for services in these two pools (Liu, Ren and Liu, 2013), as given below.

$$z'' = (z_1'', z_2'', z_3'', z_4'', z_5'') = (0.5047713, 0.520144, 0.507632, 0.523318, 0.509032)$$

$z_1'', z_2'', z_3'', z_4'', z_5''$ represent the service values of Youku, Tudou, PPS, Letv, and iQIYi, together with their content offers.

Step 4: Calculating the Overall Utility for Complex Services

In this step, we first use Formula (2) to calculate $U_i(f)$, which represents the utility of complex service i on path f . We then apply Formula (1) to calculate the overall utility $U(A_f)$ (e.g., the weighted service value) for any configuration A_f of a complex service on path f .

To determine the service weights in Formula (1), we applied the expert scoring method similar to Step 2.3.

As an example, the overall utility of a complex service on path f : Samsung→China Union→iQIYi can be calculated by instantiating Formula (1), as follows.

$$U(A_f) = \sum_{i=1}^{3} \mu_i U_i(f) = \mu_1 Z_2 + \mu_1 Z' + \mu_3 Z_5'' = 0.7835$$

Where μ_i = (0.39, 0.41, 0.20) and z_2, z_2', z_5'' represent the service values of Samsung, China Union and iQIYi respectively.

Figure 3 depicts a set of complex services jointly offered by service providers on the MPVSVN in China and their service values.

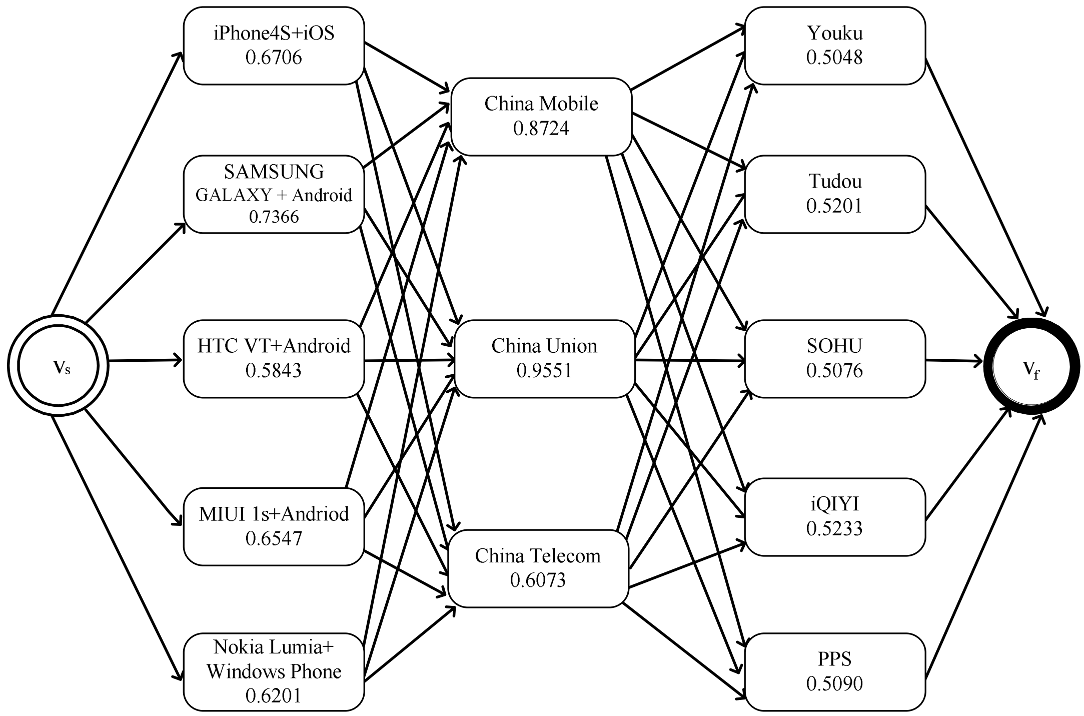

Figure 3. Some Complex Services offered by the MPVSVN in China and their Service Values.

DISCUSSION OF RELATED WORK

As stated in the Introduction section, SVNs are a new research area. This section discusses what has been done in this area and where existing work is lacking or can be extended.

Some scholars have provided the concept of value and the framework of service value network. Allee (2000) constructed a value network that encompasses not only the flows of products, services, and revenue, but also knowledge and information. However the network did not make a distinction between goods and services. Hamilton (2004) defined service value network as the value chain through the commercial collaborative flexibility to provide the services or products dynamically, and analyzed the formation process of the service value network based on e-commerce. Vargo et al (2008) studied value and value co-creation from the service system and service logic perspective. They described the process of value co-creation through interaction and integration of resources within and among different service systems. Blau, Kramer, Conte, and Dinther (2009) and Blau, Weinhardt, Dinther, Conte, and Xu (2009) introduced the formalization of service value networks as consisting of a set of service providers that supply a portfolio of service offers that provide described functionality. They proposed an abstract service value network model. In this paper, we have instantiated their model to analyze the SVN in China's MPVSs and demonstrated the practical applicability of their conceptual model.

Some researches focus on the rules and service strategies that different service providers should comply with. Holzer and Ondrus (2011) examined different roles in the mobile application value chain and determined how mobile network operators can position themselves in today's turbulent new market. Jarvenpaa1and Loebbecke (2009) studied service strategies in mobile television for three Italia companies based on the theory of consumer's experience value. They used the perspective of the benefits experienced by customers to provide the insight into how supplier firms may be able to increase the consumer value. However, these proposals have only focused on the development of static models and provided no empirical research support and algorithms that can be implemented. Consequently, the questions as to how to measure the value of different services and how to create more value for customers remain unanswered. In this paper we have defined a utility function for calculating the service utility and demonstrated this function through a real world case study.

Most work on value networks has concentrated on the enterprise-level. For example, Basole and Rouse (2008) studied value networks for aviation, automobile, retail, health care and telecommunication. They pointed out that factors affecting value networks include technological, social, and economic policy, and these factors affect inter- and intra-organizational collaborations. Their work has not focused on the mobile service field. Zhang et al (2006) and Wu et al (2007) studied the value chain and the value network of the mobile business. Karhu (2007) constituted a value network for the mobile television service. Li (2009) proposed that customer value promotes industrial value of mobile business and analyzed the value formation mechanism in Chinese mobile commerce industry. Al-Debei and Avison (2011) identified several main mobile business model dimensions along with their interdependencies and showed that these dimensions contributed to a new 'boundary-less' globalization landscape.

Very little effort has been made on value calculation and analysis. Chen et al (2007) proposed a 3V3D innovation model, and showed how to create, improve and obtain the value through value proposition, value deployment, and value appropriation. They studied the processes of design, development and delivery of new services at the enterprise level, and established the relationship between the services through a business model. However this work was carried out in the context of enterprise value networks, rather than the value networks that concern both service providers and consumers.

Our method involves solving a multi-attribute decision problem (MADP). This problem has several solutions. For example, Xu (2003, 2004) presented an optimization approach based on a complementary judgment matrix obtained from customer preferences. Zhang, Qu and Xin (2008) developed an optimal decision model based on the traditional ideal point. So far, however, little work has been done to synthesize the objective factors and subjective factors such as consumer preferences and expert judgment. In this paper, we have introduced a multi-objective optimization method, which integrates the objective factors and subjective factors effectively by combining the preferences of consumers and the natural attributes of services.

In summary, although work on mobile services based on value networks has already begun, existing research has been mainly confined within enterprises, with little attention to the relationship between the mobile service providers. Our view is that the value network model should be constructed based on the mobile service providers. This paper has presented a pilot study of the SVN from the service providers' perspective and developed an approach to calculating the service utility based on a specific SVN – the MPVSVN in China.

CONCLUSION

This paper seeks to address some practical problems in current SVNs research. The contribution of the paper is three-fold: First, based on an existing theoretical SVN model, we have produced a design for the MPVSVN in China. The design has demonstrated the practical applicability of the SVN model. Second, we have introduced a service utility function and based on this function we have formulated a systematic approach to calculate the value and utility of services on the SVN. Third, the paper has demonstrated our approach in detailed steps through real world service examples identified from the MPVSVN. Overall, the paper has made an important contribution to the work in SVNs.

Our approach, while general, has suffered from two major limitations. First, its calculation methods are too complex and time consuming. In the paper, we have only used these methods to calculate one complex service. An automated software tool is needed to calculate the utility for all potential complex services. Second, although our approach has employed a multi-objective decision support method for optimizing the attribute values, this method has not been tested in the real industry setting.

To address these limitations, our future research will seek to develop computer-assisted tools to support our approach. In addition, we intend to study and identify recurring complex service patterns and integrate such patterns in the SVNs to maximize the overall value. Finally, we will improve our approach through more real world industry case studies.

ACKNOWLEDGMENTS

We wish to thank two anonymous reviewers and the mini-track chair for their helpful comments. Our gratitude also goes to Professor Hao Shen for his kind help with calculating CSI of video clients. The work reported in this paper is supported by the National Natural Science Foundation of China, Grant No. 71172040.

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