

Customer-Driven Value Co-creation in Service Networks

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Abstract Service Dominant Logic (SDL), a contemporary view of services as a foundation of all economic exchange, takes a very high level perspective of provider–customer interaction. The role of the customers in value creation is emphasized but their role in the creation of the value proposition choice sets is not explicitly considered. From another perspective, the notion of value co-creation addressed in existing Service Science studies often assumes the value proposition to be static – i.e., proposition/acceptance happens before the start of service and is not revisited again during the service. This paper attempts to connect the macro view of SDL to the system view of Service Science in creating a framework of Service Value Network (SVN) that accounts for both provider and customer driven value co-creation.

Keywords Service value network · Service dominant logic · Value proposition · Customer value equation · Value co-creation framework

1 Introduction

The system view of Service Science considers a service system as a dynamic configuration of resources to create value, including people, organizations, shared information (language, laws, measures, methods), and technology, all connected internally and externally to other service systems by value propositions (Spohrer et al. 2008). In addition, a service system can be regarded as a resource itself and may be composing, recomposing and decomposing over time. In effect, a service system is comprised of service providers and service clients working together to co-create value in complex service network (Tien and Berg 2003).

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In the current Service Science literature (Qiu 2007) (Vargo et al. 2008), authors often assume the value proposition to be static (i.e., proposition/acceptance happens before the start of service delivery and is not visited again during the service delivery¹) and the composing, recomposing and decomposing of SVNs are determined based a given static value proposition (i.e., the static value proposition determines the connections and relationships among service participants). Taking the automobile firm example from (Vargo et al. 2008), a customer derives value when he/she actually uses the car and in accessing the firm's maintenance or towing services provided by the firm's suppliers together with the customer's personal driving skills and the public road-ways. In other words, the value proposition is determined by the provider before the value is delivered through a co-creation process between the customer (that may exert private or public resources) and the provider (that engages resources through the collaborative parties in its SVN). This is the basis of the SDL propositions (Vargo and Lusch 2004, 2008).

In this paper, we extend the concept of value co-creation and SVN to consider the view that the customer receiving the value proposition from the provider can be empowered to dynamically enhance more value based on his creation/choice of service network end points. This extension moves the relational aspect of value co-creation (Lusch et al. 2008; Vargo and Lusch 2004, 2008) to a broader view of the customer determining the values and activities in SVN (e.g., see Basole and Rouse 2008). In other words, the resource integration view emphasized the problem-analysis and specification perspective with the given static value proposition from the provider side. This paper addresses the symmetry of providers and customers that can be empowered and drive the new perspective for SVN's design and development (cf. generator-conjecture-analysis in Roozenburg and Cross 1991).

We consider the following questions in this paper: What are the determinants of value co-creation considering both the provider and the consumer versus our proposed customer driven value co-creation? What are the determinants and elements of customer driven-SVNs? How do we describe SVNs? What are the incentives and the methods for service providers to embrace customer-driven SVNs? A value co-creation framework and a SVN model are presented in this paper to address the questions above and expose future research opportunities that would contribute to the discipline of Service Science, Management, Engineering, and Design (SSMED) (Spohrer and Kwan 2009).

The rest of the paper is organized as follows: Section 2 presents a discussion of related literature, the SDL propositions, and contrasting it with the SVN concept. Section 3 presents a conceptual framework of the extended notion of value co-creation. Section 4 presents a model of a customer-driven SVN. Section 5 then discusses implications for future research with concluding comments.

¹ For example, the Interact/Serve/Propose/Agree/Realize (ISPAR) model in (Spohrer et al. 2008).

2 Related Literature

2.1 Provider Centric SDL

In SDL, service provision and value co-creation are derived from an interactive process and the provider and the customer are considered in an inherently relational context (Vargo and Lusch 2008). In this perspective the provider determines the value proposition but the value is delivered from the collaboration of the provider and the customer established through their relationship (Vargo and Lusch 2008). This is illustrated in Fig. 1 (Lillrank 2008).

Further detailed this relational context in terms of three types of encounters (emotion, cognition, behavior) as shown in Fig. 2.

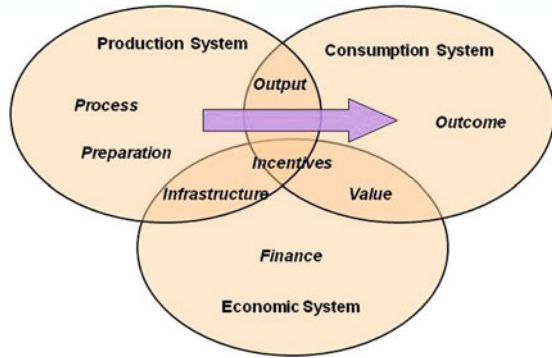


Fig. 1 The context of value co-creation [adopted from (Lillrank 2008)]

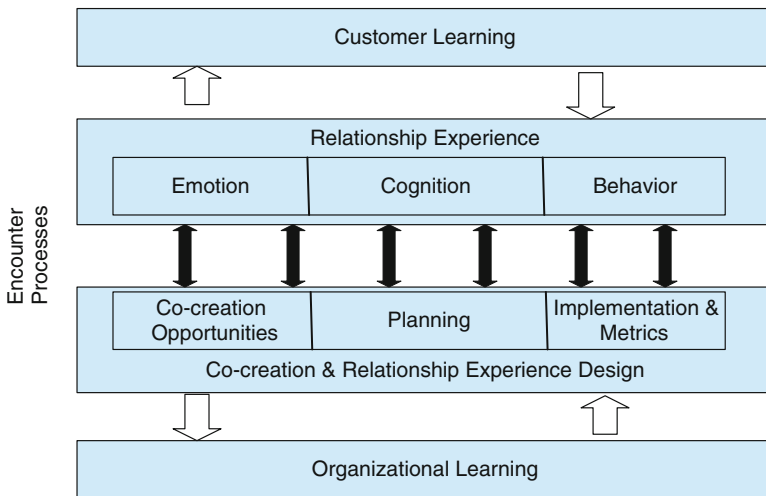


Fig. 2 Managing the co-creation of value [adopted from (Payne et al. 2008)]

In Fig. 2, the relational context involves the customer's value creation process in performing activities to achieve a particular goal through some information, knowledge, skill or other resources that they can access and use. The relationship also involves the provider's value creation processes by way of the design and delivery of customer experiences through an examination of co-creation opportunities, planning, testing and implementing the customer's encounters (represented by a series of two-way arrows linking the customer processes with the provider processes in Fig. 2). These encounters could be lending emotion, cognition, and behavior support to the customers.

In the following, we attempt to extend the provider-centric SDL view to promote a more prominent role for the customer in driving the value co-creation process.

2.2 *Provider Centric SVN*

A service provider can deliver value by re-sourcing through collaborative parties which unfolds into a value creation network (linear or non-linear). In the case of Nike, Inc. the enterprise does not manufacture or handle the physical movement of its tangible products but leverage information by applying its competences to design products, build brand, marketing, and outsourcing most other functions to the value network (Lusch et al. 2008). In our discussion, we consider this type of networks as a provider centric SVN. The following examines the motivation behind variations of this characterization of SVN that are addressed in various studies.

- *SVN as an entity flow model for offerings and revenues*: SVN is a flow model with economic entities as the basic unit of value creation and offerings/revenues as the materials flowing among economic entities, and the network is the vehicle for broadcasting production coordination information (Caswell et al. 2007). Each entity would examine the value derived from participating in the SVN as opposed to not participating (or participating in another SVN) and would estimate how this participation value changes over time in the business processes (Caswell et al. 2008). This SVN interpretation is a straightforward evolution from the traditional value chain notion in manufacturing industries to the value-creating network notion in service industries.
- *SVN as a mash-up network*: SVNs are goal-oriented business networks, which provide value through the agile and market-based composition of complex services from a steady open pool of complementary as well as substitutive standardized service modules with the use of ubiquitously accessible information technology. In other words, a SVN works like a mash-up characterized with easy and fast integration (Blau et al. 2009). This SVN interpretation puts the emphasis on the process productivity in SVNs in terms of their composition.
- *SVN as a living system with pattern, structure, process*: A SVN is a living network of tangible and intangible value exchanges characterized with patterns (configuration of relationships between the system's roles), structure (physical embodiment of the patterns), and process (activities involved in the continual embodiment of

the system's patterns of relationships) (Allee 2002). The exchange is the molecular level of economic activity and the patterns of exchanges describe how participants add/extend/convert values to produce the resulting impacts. The network also serves as the primary economic mechanism for value conversion and the value creation dynamics is described in either tangible (good, service, revenue, etc.) or intangible forms (knowledge, benefit, etc.). This interpretation delineated the necessary elements to form a SVN.

- *SVN as a mechanism for competitive innovation*: A SVN is a set of relatively autonomous units that can be managed independently, but operate together in a framework of common principles and Service Level Agreements (SLAs). The relationships among the firms in the network are essential to a SVN's competitive positions (Peppard and Rylander 2006). The structure of the network also plays an important role in firm performance and in industry evolution (Madhavan et al. 1998). The values of the relationships are three folds: (1) customer intimacy (2) product service innovation and, (3) operational excellence. This SVN interpretation considers the extension of the network boundary to incorporate the opportunities for service innovation.

From the descriptions of SVN variations above, we contend that there is a need to extend the scope of SVN from the static SVN boundary to a dynamic SVN boundary in order to incorporate more service value varieties and more service innovation opportunities. This could be attractive to the focal service provider as long as the incentives are sufficient and the cost of operating the network remains affordable (e.g., handled with ICT). This *customer-driven value co-creation SVN problem* is also very challenging for the service provider since it requires the shifting of the control foci to the customer. In the case of Nike, Inc., it can deliver enhanced value to its customers by integrating customers' resources and collaborative parties into its value creation strategy (e.g., sponsoring runners in a marathon as part of a marketing campaign.) An exploration of this problem is conducted in the next sections to lay the foundation for further in-depth research.

There are some other studies related to the customer-driven value co-creation problem. For example, Evert Gummesson (2010) mentioned that co-creation of value should consider expanding the notion of service encounter: (1) In the traditional notion, service encounter refers to face-to-face interactions between a service provider's frontline employee and a customer based on the understanding that services are produced, delivered and consumed during the interactions; (2) However, this notion should be regarded as only a special case in the extended context of the provider-customer interactions; (3) During a service delivery, customers can interact among themselves (i.e., C2C) in addition to customers engaging in B2C/C2B interactions. Other related works in the literature include customer-driven innovation (Pellican and Homier 2005; George 2006; Selden and MacMillan 2006) in which the main idea is to use customers (e.g., their inputs) to identify and define the innovation opportunities and customer segmentation. Anderson warned that customers might consider low cost as the primary determinant in purchases and ignore other parts of the service provider's value proposition (Anderson et al. 2006).

3 Extended Value Co-creation Framework

In this section, we examine the notion of value co-creation and explore the opportunities for incorporating the consideration of customer-driven value varieties and service innovation. We will then present a framework to analyze the potential opportunities and illustrate it with a case scenario.

Employed a feedback-loop to represent customer value within the framework of a service profit chain. This representation of the strong relationships between profit and customer loyalty, employee loyalty and customer loyalty, employee satisfaction and customer satisfaction is shown in Fig. 3. The central part of Fig. 3 shows a customer value equation formulating the value of the delivered service as the results created plus the quality of the delivery process (manifested as the quality of the service experience) over the sum of price of the service and other costs in acquiring the service. The provider’s value proposition is represented as the denominator of the equation. The customer’s determination of value is represented as the trade-off between benefits received (the numerator: results plus quality of service) and costs (the denominator). Note that the customer has no apparent role in determining the value structure in this formulation. The assessment of value from benefits of the results and the quality of the experience are post-hoc determinations.

Harvey (2005) extended the customer value equation further by introducing the element of self-service experience as shown below:

$$Value = \frac{Results + ServiceExperience + SelfServiceExperience}{OverallCost} \tag{1}$$

Harvey illustrated the equation with the following example: If a user is trying to lose weight, the results he/she is seeking is different from those looking for a gastronomic experience. Consequently, the value of the added control over calorie intake that the user gets from preparing a home meal (self-service experience) would out-weigh the enjoyment of a five-star service (service experience) offered

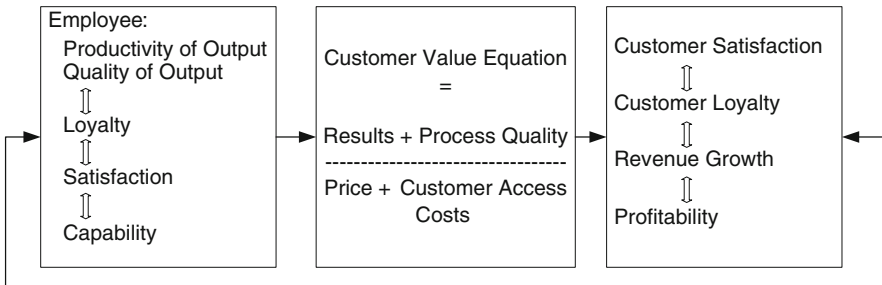


Fig. 3 Elements of service profit chain [adopted from (Heskett et al. 1997)]

at the restaurant. Instead, the user can ask to take out the materials and prepare a low-calorie meal with the ingredients at home. This value equation advances Heskett’s equation by considering potentials for value varieties offered by the provider side by incorporating self-service experience on the customer side.

Another perspective was presented by Goukens et al. (2009) who provided evidences that self-aware customers (those who focus their attention inward) were not only more selective in their information acquisition but also more likely to search for alternatives. In this case, intentional manipulations of customers’ self-awareness could prove beneficial by enabling customers to make choices that better match their personal preferences to achieve higher choice satisfaction. In the aforementioned five-star service experience example, the user can acquire good information from his/her social network and then make choices about which five-star services to experience (or in a reverse-auction scenario, create choices and receive bids from five-star services). Taking this perspective of self-aware customers, we extended (1) into the following:

$$Value = \frac{CustomerChoices + Results + (Self)ServiceExperience}{OverallCost} \tag{2}$$

In (2), the additional consideration of customer choices (as supported by the customer’s own network) changes the notion of value co-creation as addressed in SDL and SVNs.

3.1 The Framework

In this subsection, we propose a framework to analyze the possible scopes of delimiting the variations in SDL and SVN. This framework is based on the determinants of value co-creation as shown in Fig. 4. These determinants include value propositions from the provider and the customer, the provider-centric network, and the customer-centric network. These networks could be organized statically or dynamically.

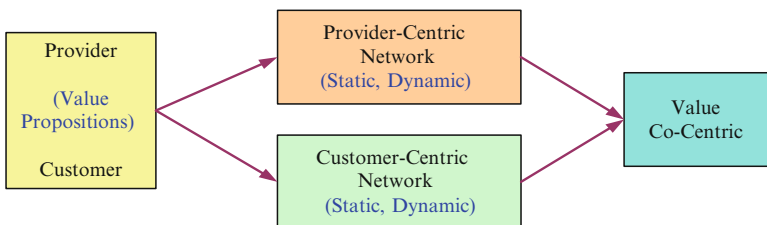


Fig. 4 Determinants of value co-creation

These determinants of value co-creation are based on the following:

1. Network is a primary economic mechanism for value conversion and for describing the value creation dynamics.
2. The value proposition offered by a provider-centric network may not sufficiently fulfill the needs of customers in terms of their own value determination.
3. Customers might need to expend extra efforts to fill the gap - e.g., with additional self-service (Harvey 2005) or creating new customer choices.
4. This self service or creation of new customer choices could range from a simple labor effort to driving another network (e.g., a customer-centric social network) to engage in dynamic value co-creation to fill the gap.
5. The combined network could enhance customer's value as long as the increase in overall cost does not offset the magnitude of the increase in value in (2). By the same token, provider's value could also be increased because of the expected increase in sale volume (e.g., due to increased customer retention). This could also decrease the cost of offering the service as well as warrant an increase in price because of the service innovation opportunities created. In short, the notion of value co-creation could be extended to incorporate the opportunities for value varieties and service innovation.

The framework incorporates the following scenarios of service network creation:

- *Provider Static*: The service network is already determined by the provider and the end points of the network are known.
- *Customer Static*: The customer does not have any way of altering the end points of the network – they have to select for the predetermined end points.
- *Provider Dynamic*: The service network is created dynamically by the provider. For example, through some cost optimizing algorithm in choosing the intermediate nodes (partners, etc.) This can also apply to the situation where cost is not the only consideration (e.g., reduction in carbon footprint or other sustainability considerations).
- *Customer Dynamic*: The end points of the network are not known ahead of time. The customer creates these end points to maximize their value from the service. That is, the value proposition from the provider only provides some pre-determined value accepted by the customer who then is empowered to enhance the value based on their creation of the service network end points dynamically.

The static cases of value co-creation in which the provider's value proposition is well defined and when the customer accepts, then the outcomes are very much predictable. However, the value co-creation in the dynamic cases is less predictable since extra efforts are engaged either by the provider side or the customer side to achieve extra benefits.

Figure 5 shows the extended framework with the four variations of SVNs and they are schematically represented in Fig. 6.

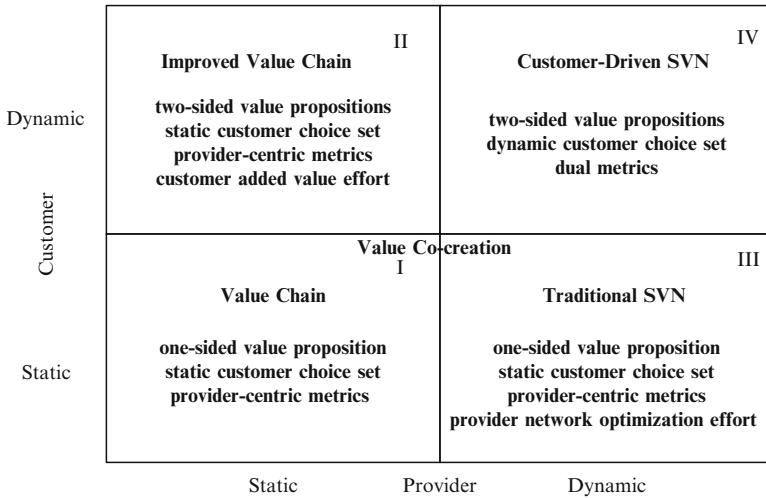


Fig. 5 Framework of extended value co-creation in SVN

1. *Value Chain* is characterized by a one-sided (i.e., provider) value proposition and thus the value varieties for customer and the metric of service quality are predetermined.
2. *Improved Value Chain* is characterized by two sided (i.e., both provider and customer) value propositions but the customer side has to expended extra efforts to enhance their own value beyond the provider’s service quality and metrics.
3. *Traditional SVN* is characterized by a one-sided (i.e., provider) value proposition and thus the value varieties for customer and the metric of service quality are predetermined, but the provider side would expend extra efforts in optimizing the network for the service delivery.
4. *Customer-driven SVN* is characterized by two sided (i.e., both provider and customer) value propositions and the customer side’s network will be involved to co-create the value with the provider’s network.

The Customer Driven Service Value Network represented in Fig. 6c depicts the customer and service provider as symmetric network integrators and sources of value propositions. The customer’s ability to drive the value creation is recognized in these explicit roles which go beyond the notion of customer and service provider as resource integrators expounded in SDL.

3.2 Case Scenarios

Scenario 1 – The value proposition from a cable or satellite television service provider to a customer is very simple – programmed entertainment from multiple channels is provided for a subscription fee. This value proposition is static and does

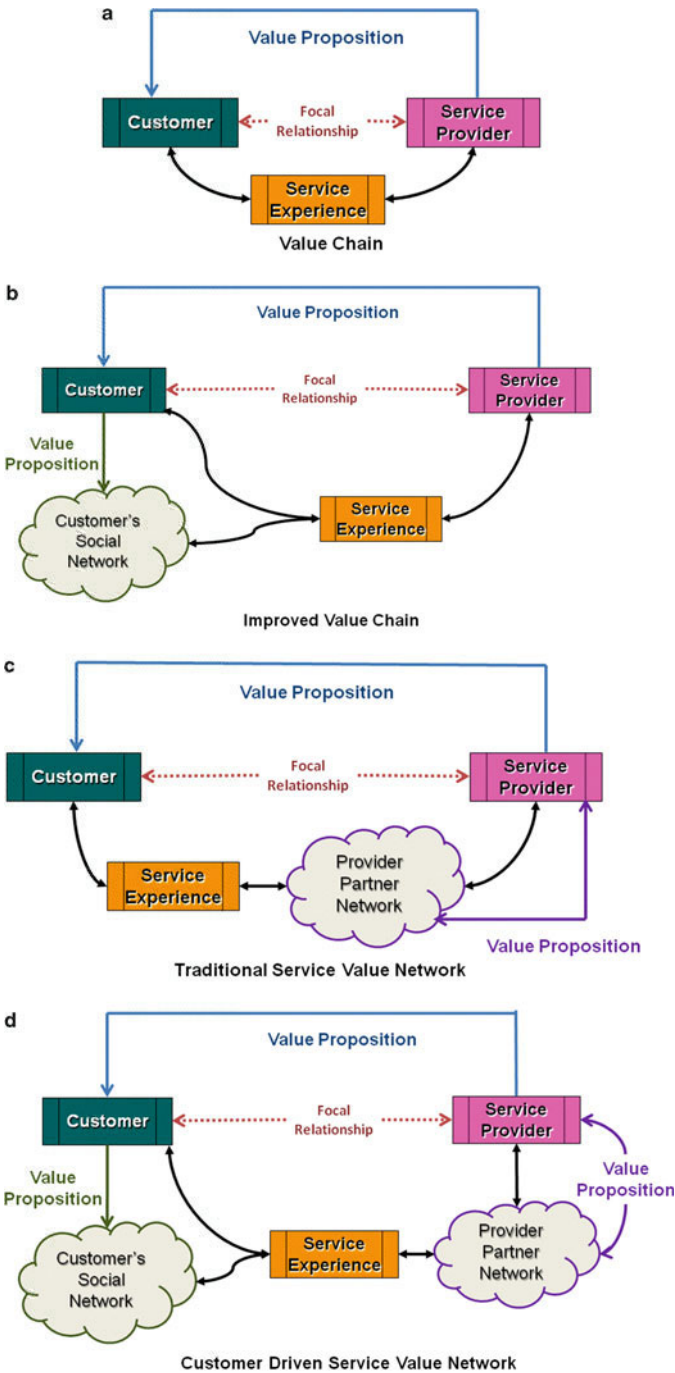


Fig. 6 Schematics of framework of extended value co-creation in SVN

not change when the customer is receiving the entertainment value. The only role the customer plays is to choose from a program guide based on his/her preferred genre of entertainment. This is true even with programs that are “on demand” where the entertainment choices are deterministic. Recently, some television service providers are also providing broadband internet and phone connectivity as a service bundle (sometimes called triple-play packages). The internet connection provides a parallel channel of communication for the customer. The customer could be connected to his/her internet social network site while watching a TV program.² In some cases, the connection interface is displayed on the TV screen. In this scenario, the customer could choose who to share the entertainment value with by connecting to a (sub)group of preferred friends in the social network and invite them to watch the program together. Conceptually the customer is inviting virtual friends to share the entertainment on a virtual couch in a virtual family room. In effect, this sharing increases the customer’s value by enhancing his/her social capital³ and is completely customer-driven. This transforms a traditional value chain proposition to a customer-driven SVN.

Scenario 2 – From the perspective of the TV service provider, the added cost associated with provisioning for the service bundle in Scenario 1 is partially off-set by charging the customer additional service fees. This increase in revenue is insignificant in comparison to the additional revenue that could be garnered from advertising. The traditional value proposition the TV service provider to advertisers is also simple – broadcast ads with certain programs to reach some target audience with certain demographic profile. This is a static 1:M proposition – M being some purported target audience. This proposition is more attractive than the hit-or-miss advertising in newspapers where the demographics of M are even more difficult to ascertain. The value proposition from the TV service provider to advertisers for Scenario 1 is more attractive and could result in increases in advertising revenue. Firstly, the TV service provider has demographic information about its subscribers which could be used to direct targeted advertisements (albeit without violation of the user privacy agreement). Secondly, the TV subscription customer through his/her social network is providing additional connections that will be exposed to the advertisement. In effect, the value proposition from the TV service provider to the advertiser could be phrased as a 1:M:N dynamic proposition. In the extreme case, if it could be done legally within the service provider’s privacy agreement with the customer, a 1:1:N dynamic proposition could be the result.

In the above we have described a user-driven value co-creation in scenario 1 and have also shown how the service provider could leverage the customer’s social networking connections to enhance revenue in scenario 2.

²Lawton (2008) described new television ventures that promise to bring the community-building features of the Web into the living room.

³Social capital could be interpreted as an aggregation of social cohesion and personal investment in the community.

4 Customer-Driven Value Co-creation in SVNs

In Sect. 3, we described the motivation for customer-driven value co-creation that could be realized through SVNs. This section presents a model to describe the customer-driven SVN in terms of its components and shows how the customer-driven SVN is superior to the other three network variations. This model also inspires some new research issues in Service Science. For the methods to develop customer-driven SVNs, we assume there are appropriate scalable ICT technologies that can be used to control the costs of building a complex network while preserving incentives for the providers.

The salient properties of a customer-driven SVN represented in the model are presented in Table 1. The goals of a customer-driven SVN include service productivity (e.g., the cost of building the network and its relationships), customer satisfaction (e.g., increase in value varieties with more choices such as self-service), and service innovation (e.g., from innovative design of the choices).

The network is built with human tacit knowledge and interdisciplinary theories to be applied to ensure certain solution qualities (e.g., minimized cost, maximized satisfaction, maximized opportunities for service innovation). Moreover, the network development and operation can be managed and facilitated by particularly designed ICT artifacts to minimize the operating cost. Examples of related ICT artifacts include the mechanisms to semi-automate the value co-production process (e.g., Tung and Yuan 2010), the mechanisms to conduct cloud service governance and integration (e.g., Plummer and Kenney 2009), etc.

4.1 Model of Customer-Driven SVN

In this section, we will first provide a representation of the model for customer-driven SVNs, followed by the comparison among the four variations of SVNs shown in Fig. 6 and demonstrate that customer-driven SVN is superior to the other three according to the extended customer value function of (2). The model of a customer-driven SVN presented in the first part is based on the formalism suggested by (Conte et al. 2009) while focusing on the value that could be derived from customer choices in (2).

Table 1 The salient properties of a customer-driven SVN

The salient properties	The shared reality of value co-creation
Goals	Service productivity, customer satisfaction, service innovation
Problem solving strategy	Networked collaborative services
Solution requirements	Minimized cost, maximized satisfaction, Maximized opportunities for service innovation
Theories	Inter-disciplinary
Tacit knowledge	Information, knowledge and decision of people involved
Design method	Synthesized artifact

4.1.1 Representation of Customer-Driven SVN

For a focal relation containing a focal provider v_{pf} to which a focal customer v_{cf} places the request of service directly (or indirectly) as depicted in Fig. 5, the definition of customer-driven SVN is formulated in terms of its universe and the members of the universe. In a customer-driven SVN universe ($G = (\{V_P \cup V_C\}, E)$, N^P, N^C, P^P, P^C), G represents the network of nodes $\{V_P \cup V_C\}$ and edges E ; N^P and N^C respectively denote the provider-side network and the customer-side network; P^P and P^C represent the respective value propositions. In our model, the goal of the network⁴ is to maximize customer's value by increasing the opportunities of value varieties and service innovation with reasonable cost as implied in (2). Each instance of value creation dynamics is assumed to have a focal relationship with a focal provider and a focal customer. The descriptions and representations of the members of the universe are itemized as follows.

- V_P : For simplicity we assume that each service is owned by a different service provider. Thus, the set of service providers V_P equals the set of services present in network G . A characteristics configuration A_{Pj} of service v_{Pj} is fully characterized with a set of M attributes $A_{Pj} = \{a_{Pj}^1, \dots, a_{Pj}^M\}$ where a_{Pj}^m is an attribute value of type m (e.g., cost).
- V_C : The remaining nodes of G (i.e., nodes excluding those in V_P). When V_C refers to only the customer's social network, V_C would contain the nodes of N^C (i.e., the customer-side of network). A characteristics configuration A_{Cj} of customer v_{Cj} is fully characterized with a set of N attributes $A_{Cj} = \{a_{Cj}^1, \dots, a_{Cj}^N\}$ where a_{Cj}^n is an attribute value of type n .
- E : Each edge $e_{ij} \in E$ denotes an integration relationship between either two service providers v_{Pi} and v_{Pj} (i.e. interoperability of offered services and their willingness to cooperate), one service provider v_{Pi} and one customer v_{Cj} , or two customers v_{Ci} and v_{Cj} . Each edge e_{ij} is annotated with the price p_{ij} where v_j is a successor of v_i ($v_i, v_j \in V_P \cup V_C$). p_{ij} can be zero such as the case of free transfer of intangible offerings (Allee 2008). On the other hand, p_{ij} can incorporate different kinds of cost considerations (e.g., production cost, relationship cost, transaction cost, etc.).
- N^P, N^C : Assume N_i is a network of a subset of connected nodes from $V_P \cup V_C$ that drives the creation of a value choice (χ_i) for customer (v_{cf}) (the sink of the network). N_i can then be represented with two sub-networks: $N_i = N_i^P \cup N_i^C$, where N_i^P is the provider-side network (containing the focal provider v_{pf}) and N_i^C is the customer-side network (containing the focal customer v_{cf}). The customer-driven SVN can then be a super set composition of the involved candidate networks (e.g., $G = \cup_i^k N_i$).

⁴ Described a network as an economic mechanism for describing the value creation dynamics.

- P^P, P^C : P^P is the value proposition of the focal provider (v_{Pf}) that is associated with the provider-side's metrics for computing the value of the network G. P^C is the value proposition of the focal customer (v_{Cf}) representing the customer-side's metrics and opportunities of new customer choices to be created. For simplicity, the metrics for the provider and the customer are constrained by thresholds of benefit and cost: λ_{Pf} and α_{Pf} are the thresholds of benefit and cost for the provider; λ_{Cf} and α_{Cf} are the thresholds of benefit and cost for the customer.

The goal of the customer-driven SVN is to maximize customer's value. Without loss of generality, the customer value function is defined as benefits minus costs. The benefit for customer is comprised of the three parts in the numerator of (2) – i.e., results, service experience (could be the assessment of the quality of the (self) service experience), and customer choices. In the universe, we assume a set of candidate networks (N_i) which can generate different acceptable value choices (χ_i) for the focal customer (v_{Cf}) with the reasonable costs (α_f) provided through the focal provider (v_{Pf}) directly or indirectly. The threshold (λ_{Cf}) for the values of the choices ($Valueof\chi_i$) is assumed (i.e., $Valueof\chi_i \geq \lambda_{Cf}$). The incurred cost of the value choice ($Costof\chi_i$) should not exceed (α_{Cf}) (i.e. $Costof\chi_i \leq \alpha_{Cf}$). In general, $Costof\chi_i$ can be computed by aggregating the prices p_{ij} along the paths in N_i (i.e., $\pi_i = \sum_{e_{ij} \in N_i} p_{ij}$).

For each value choice (χ_i), $Valueof\chi_i$ then boils down to the consideration of the benefits of the results and the service experience minus the cost, which can then be regarded as a function of the characteristics configuration attributes $A_{Cf} = \{a_{Cf}^1, \dots, a_{Cf}^N\}$, the customer value proposition P^C , and the value of the network N_i (i.e., $\varphi(N_i)$ or $\varphi(N_i^P \cup N_i^C)$). Presented a method to compute the value of a network taking into account the value accrued – i.e., benefit minus cost – due to the transfers of offerings as well as the expected value due to the partners' satisfaction in the various relationships (Anderson 1995). By adopting the greedy approach, the value of the network $N_i = \varphi(N_i^P \cup N_i^C)$ can be considered as a function φ of two parts: the value of the provider side's network $\varphi_P(N_i^P)$ and the value of the customer side's network $\varphi_C(N_i^C)$ that can be computed with the Caswell's method. The value of $\varphi_P(N_i^P)$ are bound by the thresholds of benefit and cost for the provider ($\lambda_{Pf}, \alpha_{Pf}$). The network values $\varphi_P(N_i^P)$ or $\varphi_C(N_i^C)$ has to be greater than zero for them to be viable and have enough incentives to satisfy both the provider's network and the customer's network in order to sustain the provision of the results and the service experience for the customer. In other words, network viability has to be satisfied in the computation of $\varphi_P(N_i^P)$, $\varphi_C(N_i^C)$ and thus $\varphi(N_i)$.

To represent the customer-driven SVN, we let $G = \cup_i^k N_i$ for k that satisfies $\chi(A_{Cf}, \varphi(\cup_i^k N_i)) \geq \max(\chi(A_{Cf}, P^C, \varphi(N_1)), \dots, \chi(A_{Cf}, P^C, \varphi(N_k)))$, i.e., the weaker form of super set composition of the involved candidate networks. This representation allows us to maximize the customer value function shown in (2) by considering the customer choices, the results and (self)service experience with respect to the overall cost.

4.1.2 Comparing the Four SVN Variations

To compare the four variations of SVN (Value Chain, Improved Value Chain, Traditional SVN and Customer-Driven SVN), we use the benefit parts in the numerator of the customer value function (2) together with the universe of customer-driven SVN ($G = (\{V_P \cup V_C\}, E), N^P, N^C, P^P, P^C$) with respect to the overall cost:

- *Value Chain*: The characterization of a one-sided provider value proposition and a static provider network structure implies that V_C, N^C, P^C and hence N_i are null. Accordingly, there will be no benefit accrued from the part of customer choices for the customer. Meanwhile, the cost of operating N^P for the provider will be higher than that of Traditional SVN which optimizes the operating cost of N^P .
- *Traditional SVN*: Similar to Value Chain, it is characterized by null V_C, N^C, P^C and hence N_i . The provider operates N^P by minimizing costs. When assisted by appropriate scalable ICT technologies, some of the costs could be minimal. In the long run, this could lead to lowering the overall cost for the customer when compared with using the Value Chain approach.
- *Improved Value Chain*: Given the characterization of two sided (i.e., both provider and customer) value propositions with the customer's extra efforts expended to enhance their own value beyond the provider's service quality and metrics, V_C, N^C , and hence N_i are null. Accordingly, there will be no benefit accrued from the part of customer choices for the customer; meanwhile, the overall cost of achieving P^C will also be increased.
- *Customer-driven SVN*: Given the characterizations of two sided (i.e., both provider and customer) value propositions and the customer side's network will be involved to co-create the value, there will be the three parts of benefit (i.e., results, service experience, customer choices) accrued and the overall cost can be minimized by operating and managing the network with appropriate scalable ICT technologies.

From the above analysis, it is obvious that customer-driven SVN is superior to the other three SVN variations according to the extended customer value function of (2) when the proper ICT technologies are in place to assist the operation of the overall networks.

4.1.3 Implications to Service Science

Based on the framework of extended value co-creation in SVN and the customer-driven SVN model ($G = (\{V_P \cup V_C\}, E), N^P, N^C, P^P, P^C$), there are some research issues that could be explored in the future. In the following, we provide a brief discussion of these issues in light of the four aspects of Service Science, Management, Engineering, and Design – SSMED (Spohrer and Kwan 2009):

- *Design*: With the incorporation of customer value proposition P^C , the human-centered design methodologies can be introduced into the study of Service

Science. For instance, Design Thinking is a systematic methodology with seven stages (define, research, ideate, prototype, choose, implement, and learn) that can empower the development of customer-driven SVNs that allow creating choices with empathy meaningful to the customers.

- *Engineering*: To minimize the cost of operating and managing N^P for the service provider, there should be more studies of ICT artifacts specifically designed to facilitate the development and the operation of the customer-driven SVNs. In addition, dynamic ways to combine N^P, N^C and enable the communications between the two sub-networks should also be investigated.
- *Management*: Given the value propositions from both the provider side P^P and the customer side P^C , new service strategies and quality measurement to ensure the goals of service productivity, customer satisfaction and service innovation should be investigated.
- *Science*: Given P^C and N^C are considered, new service system entities and interactions (e.g., new choice identification) are introduced. Accordingly, different models of the possible interactions and their governance should be explored with simulation and virtual reality experiments.

5 Conclusion

In the current unsteady economic environment the business ecosystem is increasing more competitive and complex. Customers are also becoming savvier, demanding more information, access and choices. An example of that is the demand trend for more user-created content on the Internet (oft called Web 2.0 phenomenon). This also led customers to create their own social network based on specific social value propositions and not dependent on static value propositions from the service providers. This paper provides a framework that shows the different variations of service value networks. In particular a model of the customer-driven service value network was formulated and explored. The relationship between the model and the discipline area of SSMD was also discussed.

The customer-driven value network concept extends the contemporary Service Science and SDL propositions to provide the customer a more prominent role in value co-creation. Future research in this area includes empirical studies of customer-driven value networks (such as scenarios described in Sect. 3.2), empirical evaluation of (2), and studies of the behavioral aspects of customers in dynamically generating network endpoints.

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