In search of the holy grail: An exploration of value co-creation in service ecosystems using knowledge network analysis

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ABSTRACT

The intention of this article is to simplify the study of value co-creation both from a deeper theoretical discourse, including knowledge networks approach. The study's approach is from the perspective of knowledge sharing, in form of interaction and resource integration. We outline the central premises of value co-creation as fundamental in service ecosystems and resource integration concepts. It is also expounded how not just interaction, but how service interaction enhances value co-creating processes, by enabling an actor to enter the value creating processes of other parties, support them, and benefit from them. The article does emphasize processes of value co-creation, including its outputs and outcomes. Knowledge sharing is encapsulated within the concepts of resource integration and service interaction among actors. The knowledge network analysis technique is used as a methodology, while preliminary data from KAMOMI water supply service is used as a case illustration. The case is used to tentatively indicate how resource integration and interaction seem to influence value co-creation, while also using knowledge network analysis quantitatively. Two models are developed. The first model exemplified the theoretical drivers of value co-creation, while the second described the structural characteristics that influence value co-creation in form of knowledge sharing. Four propositions are advanced to supplement the study's theoretical insights. Given the perspectives of knowledge networks, the article makes knowledge contribution to the ongoing academic debate on value co-creation in service ecosystems.

CCS Concepts

• N**etworks→ Network measurement • Networks→ Point-to-point networks.**

Keywords: Service ecosystems; value co-creation; knowledge networks; knowledge sharing

1. INTRODUCTION

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Value co-creation in complex networks of actors is presented as seemingly a very hard concept to achieve. This is evident in the use of ambiguous expressions and unclear statements. In [1], it was elaborated that service science is the "systematic search for principles and approaches that can help understand and improve all kinds of value co-creation. Service science is centered on the study of value co-creation within and among service systems—dynamic and adaptive webs of exchange composed of interactions among people, organizations, and technology [2]. In the same manner, service-dominant (S-D) logic, and its definition of service as the application of resources for the benefit of another, centers on the concept of value co-creation [3] and [4]. More recently, S-D logic has progressed beyond the nascent perspective and framework stage, and the associated literature has evolved since its introduction in 2004 [4]. Since then, the original foundational premises have been revised, elaborated, and extended, see [3]. This development has led to the introduction of a service-ecosystems perspective, which is based on S-D logic [5] and [6]. Service ecosystem view is being argued to provide a framework for studying systems of service systems—or the interaction and value co-creation among multiple service systems [7].

Value co-creation in complex networks is specifically addressed in this article from knowledge sharing process which will be explained within the concepts of resource integration and interaction. Resource integration is the central means for connecting people and technology in service systems, and interaction factor because they influence knowledge sharing among actors within service ecosystems. Understanding value co-creation processes are of crucial importance both for the development of the theory and its practical application. To this end, we propose a service ecosystems lens in studying value co-creation, and we propose knowledge network analysis as a way of empirically understanding how value is co-created. It is expected that the methodological approach of applying knowledge network analysis to social complex project networks to be demonstrated in this article should simplify value co-creation. The article is the combination of review of literature with theoretical insights, and it is framed within a relational context by describing the process of value co-creation within resource integration and interaction.

The article is structured as follows. The origin and basics of service ecosystems is discussed according to how value has been conceptualised within service ecosystems. Interaction and resources integration are then explored emphasising their influence on value co-creation. The knowledge network analysis technique is then proposed, and how this technique can enhance value co-

creation was hypothesised. Subsequently, we provide preliminary data of a functional water supply project. The article ends with discussions on theoretical and practical implications.

2. SERVICE ECOSYSTEMS

An ecosystem perspective is essential for understanding the holistic dynamics of complex systems, which requires moving away from a firm-centred perspective to focusing on the whole context of a complex world [8]. Service ecosystems is a product of service science. Service dominant logic (S-D logic) has been recognized as an important theoretical framework for the development of service science and the study of service systems [9], [10]. S-D logic and its associated literature evolved in the marketing literature in 2004 [3]. Since then, S-D logic has advanced beyond the framework stage and emerging perspective. The revision, elaboration and extension of the concept led Vargo and Lusch's [7] and [2] to introduce the service ecosystems, which is gaining attention in the literature. In general, S-D logic posits that (1) service is the basis of exchange, (2) value is always co-created, (3) all social and economic actors are resource integrators, and (4) value is always phenomenologically determined by a service beneficiary. As discussed, [7] recently extended their views on service-for-service exchange by elaborating the concept of a service ecosystems, which emphasizes the dynamic and systemic nature of value co-creation and the influence of social factors in service-for-service exchange.

By a way of referral, let there be a digression to the biological literature of ecosystems. They are community of living organisms (biotic) as well as its environment (abiotic) factors interacting and functioning together as a unit, over time and space with other organisms and other elements in the system. The interactions among the organisms result in interdependence, necessary for joint adaptability and a source of dynamisms and emergence in the system [11]. Similarly, human systems, markets and economies are like natural ecosystems, in that they emerge, and go through sweeping changes over time. As these different processes and actors jointly evolve over time, they effect change(s) on one another in non-linear and dynamic ways [11]. Service ecosystems are defined as "relatively self-contained, self-adjusting systems of resource-integrating actors connected by shared institutional logics and mutual value creation through service exchange" [12], [11] and [6]. The actors' resources such as knowledge, skill, finance according to their expectations and needs, seem to be valuable when they are matched and positioned in a value creating network to provide benefits to all network actors. The actors' expectations and matching of their resources in value co-creation is critical, a scarce and inadequately discussed process in the service ecosystems literature. The article is expected to advance the understanding that value co-creation in the service ecosystems seems to depend on available resources including the relationships associated with actors in each service system. Given the insightful introduction, we move our discussion to how value co-creation is enhanced through interaction within the service ecosystems.

3. RESOURCE INTEGRATION

Actors evaluate available and potential resources to understand what they have and what they can do [13]. Resource integration then is the incorporation of an actor's resources into the processes of other actors. It implies a social and cultural process that enables an actor to become a member of a network. Firms act as resource integrators as specialization forces them to access existing knowledge, skills, competences, people, products and money. Value co-creation occurs by integrating actor resources in accordance with their expectations, needs and capabilities [14].

Resource integration is another crucial instrument for value co-creation, whereby two or several network actors link their resources to produce mutual benefit. Actors resources become valuable when they are matched and positioned in a value-creating network to provide benefits to all network actors [14]. But integration of resources can differ in terms of quality and quantity. There is also a need for complementarities to understand joint volume and avoid redundancy and mixed forms. In value co-creation through network interaction, co-creation strives to improve service systems through a better matching between resources, processes and outcomes. Matching is the guiding principle for resource integration; the value creation potential of an actor arises from its ability to match, to position itself in a network and contribute to its success and evolution [14]. The ability to match aim, resources and processes is the means to mutual value.

Actors have different resources that serve in different ways but need integration to bring about value co-creating process and add what is missing to the whole. In some cases, actors have similar resources and processes. Resource integration calls for exploitation to avoid redundancy. By sharing redundant information, actors facilitate the transfer of tacit knowledge. In this way redundancy forms a common cognitive ground for cooperation and integration of knowledge and other resources [15]. Broadening the scope from exchange to value co-creation, resource integration can be conceptualized as a central practice in value co-creation. This is because as actors enact practices to integrate resources, they interact with other actors and contribute to value co-creation processes, these processes intersect with other value co-creation processes and form networks of relationships—or systems [16].

Resource integration can assume different forms. This focus on resource integration helps to make a more explicit connection between practice theory and value co-creation, and it broadens the scope of market practices beyond exchange-specific practices to include those practices associated with other forms of resource integration. Such forms include; sharing [17], gift giving [18], word of mouth [19], and, more generally, specialization in knowledge and skills that are found in systems of service exchange. Thus, within the S-D logic's premise, value is always co-created in exchange provides an appropriate theoretical framework for research in service ecosystems.

4. INTERACTION

Interaction among actors is the most crucial antecedent to resource integration. During integration and application of resources for and with actors and exchange for service and service within services ecosystems, value is created. Within the concept of value co-creation, the idea is that value is created through interaction in mutually beneficial relationships. Interaction takes place to provide service and mutual benefit [5]. Service interaction enables an actor to enter the value creating processes of other parties, support them, and benefit from them. Interaction can form the nucleus for action and the actors' interpretation of the surrounding world [20], is a key driver of co-creation and a "generator of experience and value" for the whole network [21]. By interacting, people can transform their subjective meanings into artefacts and give meaning to reality. Purposeful interaction and conversation aimed to mutual benefit can drive learning by enabling processes of socialization through which a crossover fertilization of tacit and explicit

knowledge arises and activates the knowledge spiral within the network [22]. During interaction there is the transfer of knowledge, resources and learning

Actors set up a conversational process not simply to exchange information, but also to make available their knowledge and other operant resources and to create new knowledge or new operant resources [14]. Analysis of others' value creation resources and capabilities requires acquaintance-making where actors participate in shaping value propositions. In this constructive interaction aims, knowledge, experience and skills are matched and new ideas generated. In this way, actors can "get insight in what the actors can do together and for the other through access to a common meaning or shared field of knowledge" [23]. Dialog can also overcome personal positions and develop shared group meaning through the establishment of network vision and social capital [13], [22].

While the importance of networks has been stated, there is limited research that shows how social interaction and network ties advance knowledge acquisition and knowledge sharing. This fosters a process for positioning network knowledge and practices, when knowledge is not solely produced by a single actor within its practices, but by a network of actors committed to co-create value. During interaction, the actors of a network can access human, physical, technical, financial and other resources. Knowledge, products, services, and solutions are exchanged and shared by actors according to their specific evaluation (value-in-exchange). They are activated in their value-creating processes in order to achieve certain goals (value-in-use). The process of matching actors' resources within complex networks with the view of mutually generating new beneficial ideas has not been well attended to in the social interaction literature. This significant area needs to be uncovered. This should give a deeper understanding of value co-creation.

A model is presented below describing the relationship of resource integrators expectations and needs, including matching of actors resources during service interaction as drivers of value co-creation.

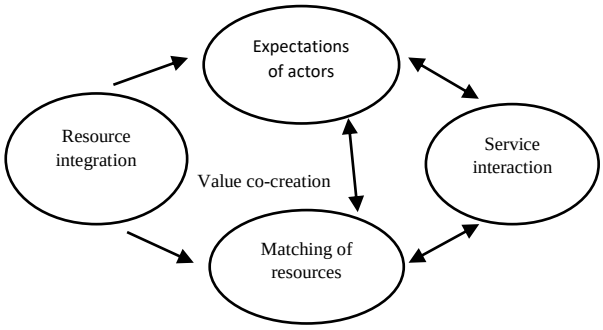

Figure 1. A model illustrating the theoretical drivers of value co-creation

5. METHOD

5.1 Method of knowledge network analysis

This section of the article described the method that seems to have the facility to quantitatively establish value co-creation in form of knowledge sharing. There seems to be usefulness of systems and network concepts in describing service systems community. These systems and network concepts are becoming central to service ecosystems as appropriate concepts for describing direct and indirect service exchange that occur in the economy and the society [24]. Knowledge Network Analysis technique (KNA) had been applied to model informal networks that organizations use to promote the lateral sharing of knowledge [25]. There are some basic concepts in constructing knowledge networks. The basic concepts include social networks. Social networks consist of peoples (nodes) and the interaction between these people (arcs) [26].

Social networks translate nodes and arcs to the domain of Knowledge Network Analysis. This results in two basic concepts: the nodes represent the knowledge actors, while the arcs represent the knowledge flows. Added to this is a third concept: knowledge areas, that require a specific knowledge management approach [10]. In [25], a knowledge area is defined as "a coherent cluster of insights, experiences, theories, and heuristics" [25]. It represents a cluster of knowledge within an organization.

There are two types of knowledge networks: knowledge pull networks and knowledge push networks according to [25]. Within the pull network, the person who needs the knowledge pulls the knowledge from the person who has it –directly (direct contact) or indirectly (based on recommendation) [25]. This requires that an employee has access to the knowledge of his colleagues.

It is also important to point out the following characteristics of KNA; knowledge role expertise level and function. Knowledge roles identify the role of an actor within a knowledge area and are derived from the knowledge management processes as described by [25]. The authors; [25] further elaborated the definitions of the knowledge properties. The first role is the knowledge creator and indicates that the actor contributes to the creation of new knowledge in the knowledge area. The second role is the knowledge sharer; indicates that the actor acts as a knowledge steward or knowledge broker. The last role is the knowledge user, which indicates that the actor is a consumer of knowledge. Expertise level is a measure for the degree or quality of the knowledge of an actor [27]. Therefore, actors with a high level of expertise are considered to perform their job better than others with a lower level of expertise [25]. The levels of expertise was pointed out by [25]. The first level is trainee, which indicates that an actor mainly possesses theoretical knowledge and heavily depends on others for the execution of his job. The second level is specialist, which indicates that an actor has mastered one aspect of the knowledge area in depth. The third and highest level is expert, which indicates that an actor has a broad experience in the knowledge area and contributes to the further development of it.. The next section described knowledge sharing because it seems appropriate to provide insights to value co-creation concept.

5.2 Knowledge sharing

Many researchers use the terms knowledge and information interchangeably, emphasizing that there is not much practical utility in distinguishing knowledge from information in knowledge sharing research [28], [29], including [22]. For example, [30] considers information to be just "a flow of messages" whereas knowledge is based on information and justified by one's belief. In [15] and [29], the researchers believed that all information is considered knowledge, but knowledge is more than just information, i.e., knowledge includes information and know-how. In the management information systems literature, the researchers tend to use "knowledge" to suggest that there is value and uniqueness in examining knowledge management system compared to the traditional information systems [31] and [18].

However, the review of literature indicated that quite a number of researchers in knowledge management domain considered knowledge as information processed by individuals including ideas, facts, expertise, and judgments relevant for individual, team, and organizational performance [31], [28]. Meanwhile, in [32], [15], [30] and [10], the authors defined knowledge sharing as the provision of task information and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies or procedures.

Knowledge sharing can occur via written correspondence or face-to-face communications through networking with other experts, or documenting, organizing and capturing knowledge for others [32] and [10]. Although the term knowledge sharing is generally used more often than information sharing, researchers tend to use the term "information sharing" to refer to sharing with others that occurs in experimental studies in which participants are given lists of information, manuals, or programs [10].

Knowledge sharing is different from knowledge exchange and knowledge transfer [32]. Knowledge transfer involves both the sharing of knowledge by the knowledge source and the acquisition and application of knowledge by the recipient [32]. "Knowledge transfer" typically has been used to describe the movement of knowledge between different units, divisions, or organizations rather than individuals [25]. Although "knowledge exchange" has been used interchangeably with knowledge sharing but it should be noted that knowledge exchange includes both knowledge sharing (and employees providing knowledge to others) and knowledge seeking (or employees searching for knowledge from others). The term knowledge exchange when discussing studies that measured knowledge sharing using scales that assessed both knowledge sharing and seeking [33]. The next section discussed how characteristics of KNA can be interpreted to knowledge sharing.

5.3 How characteristics of knowledge networks technique translates to Knowledge sharing

The KNA technique is used to study the social interaction between and among members of a particular group of people. Instead of studying social networks in this article, we study knowledge networks, these networks focus on knowledge sharing between and among the actors of the network. Therefore, typical knowledge management aspects are added to social network analysis, such as knowledge management roles, expertise levels, knowledge flow viscosity and knowledge flow velocity. These additions are used to identify structural characteristics that indicate knowledge sharing within knowledge networks. Social network analysis has already been used to study knowledge networks by authors such as [34], [35] and [37].

Knowledge networks can be analysed visually and quantitatively, just like social networks [37]. The illustration of knowledge sharing from knowledge network analysis should take the quantitative analysis for which a number of function and indicators were used in [32], [25], [35] and [22]. Some of the indicators addressed analysis on network or group level while other indicators addressed analysis on the level of individual actors (node level). The following indicators below were based on network/group level:

1) Power: An actor is said to have high power if he provides many people with knowledge (High out-degree) and the actors that he is connected to have no alternative sources of knowledge (low in-degree). This is an indicator that an actor has control/power over other actors. If an actor with high power leaves the organization, the actors that depend on this actor become disconnected what will negatively influence the growth of their expertise level (push network) and their job performance (pull network).

2) Out-degree centrality: A high value of this indicator shows central position of actors in a network, thus provides many people in a (push or pull) network with knowledge. By providing many actors with knowledge the actor is said to be influential in [37] and [25], because he reaches many actors in the (pull or push) network with his knowledge.

3) In/out-degree: The in-degree is an indicator for the number of incoming knowledge flows and the out-degree is an indicator for the number of outgoing knowledge flows of an actor. The in/out degree is used to determine the knowledge role of each actor in either push or pull network.

4) Mean shortest path: It is a measure of connections of actors and indicator for the distance between actors in the networks. A low value (<2) of this indicator for pull networks indicates that actors have good access to knowledge of other actors; it is just 1 or 2 steps away from them.

5.4 Value co-creation through knowledge sharing

Preliminary case: water service ecosystems

The purpose of this particular illustrative case study is to exemplify and help the reader in visualising how the concepts can be applied to an empirical setting. The water service ecosystem is chosen for its clear, recent, and extensive example of the core concepts presented. The case illustration under this study is a small-sized water supply service scheme called KAMOMI. KAMOMI scheme is about the construction of water projects for rural communities to a population between 3000 and 5000 in beneficiary communities. The water supply is a maximum of 50.000 litres tank capacity per day. After the construction of the water project, it gets handed over to the community for operation and maintenance. The KAMOMI schemes in study are the successful projects in terms of the functionality. The operation and maintenance team of each scheme consists 6 people with differing individual obligations. The individual roles and functions in each team include; electrician, operator and estimator, including inspection officers and end-users. The responsibilities of individuals making each team include; checking of damaged pipe, collection of payments, and water facility maintenance.

The members got selected based on established and guiding principles of KAMOMI water scheme. The team members (service ecosystem) have a collective goal of ensuring the functionality of the water supply scheme. The team members identified a knowledge area that enhances value co-creation in the water supply service in their community. The knowledge area identified by the team members for this particular illustration is knowledge of water to avert diseases. The team members believe that they all have individual resources to bring into the water supply scheme. Individual team member expected other actors to carry out their responsibilities for continuous functioning of the water scheme. In addition, at one point or the other, each member is dependent on one actor or the other to enable them function as expected by other team members.

The team holds weekly meetings. However, outside the formal weekly meetings, they interact with one another on the average of two times per week. The mode of interaction includes; face to face as well as telephone conversations. In carrying out their responsibilities, the team members at one time or the other depended on other team member for knowledge beneficial to carry out their duties. The richness or let us say the quality of the knowledge shared depends on the mode of knowledge shared. Service interaction among the team members reveals the expertise role of the members (trainee, specialist or expert). Likewise, it also reveals the knowledge roles of team members; knowledge creator, sharer and user. Knowledge sharing seems to occur within service ecosystems of KAMOMI water supply scheme.

The service ecosystems view provides a means for studying how the co-creation of value draws on and contributes to the social context through which it is derived in systems of service-for-service exchange—i.e., service systems. It is important to note that the interdependent relationships found among service providers and service beneficiaries within systems of service exchange vary widely in types of entities [5], strengths of relationships [12], and patterns of networks [16]. Value co-creation involves more than the actions and resources of a given pair of service systems, and the creation of value depends on the availability of resources as well as the relationships associated with each service system [36].

Using the preliminary data from KAMOMI water scheme, and based on characteristics of knowledge network analysis technique as a methodological approach that seems to establish knowledge sharing. The model presented below describes structural characteristics in networks that influence value co-creation in form of knowledge sharing in water service ecosystem.

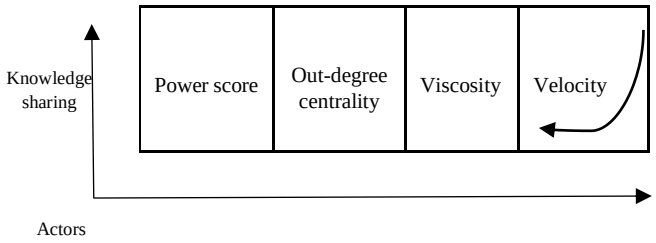

Figure 2. A model illustrating the empirical drivers of value co-creation

In figure 2, the model indicates that the higher the power score of an actor, the higher the provision of knowledge to other actors in networks. Similarly, high knowledge viscosity indicates the quality of knowledge shared, while the shorter the velocity, the quicker to quality knowledge especially if it is useful to actors.

6. CONCLUSIONS

Deeper insights of service ecosystems approach for advancing the understanding of value co-creation was explored. There were discussions on interaction among actors as it precedes resource integration which also enhances experience and value co-creation. Value co-creation process in form of knowledge sharing in a water supply service. The aim was to simplify the concept of value co-creation against its overlapping and ambiguity in the service ecosystems literature. In addition, there was a description of the role of knowledge network analysis to establish knowledge sharing as value co-creating activities. Two models were developed. One model illustrated the theoretical drivers of value co-creation and the second, the structural characteristics that influence value co-creation.

The second model illustrated characteristics of knowledge network analysis technique to expound value co-creation features in networks, using the preliminary data from KAMOMI; a water supply service that was used as an illustrative case study.

We posit

the following propositions to supplement our study's theoretical insights:

Proposition 1: Resource integration can be achieved if there are guiding principles for actors' incorporation in service ecosystems. The guiding principles can be social or cultural process.

Proposition 2: The value co-creating potential of an actor arises from its ability to respond to guiding principles of the service ecosystems.

Proposition 3: The formation of nucleus for action in service ecosystem and actors interpretation of the surrounding system are key drivers of co-creation and generator of experience and value for the service ecosystems.

Proposition 4: An active service ecosystem is fundamental for value co-creation. The activity include enacting of practices by actors and network of actors.

We have not attained the concluding model or theory, but we hope we have taken a step. We call on research to continue theoretical analysis, but seek to improve the quality of the concept of value co-creation from in-depth of empirical studies.

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