Why co-creation in service ecosystems needs an architectural view

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This article demonstrates the relevance of architecture for implementing the process of value co-creation. From the service ecosystem perspective, we show how architecture can (1) set the institutional arrangements for the coordination and involvement of actors, thereby (2) creates the prerequisites for resource integration and (3) enables value to be co-created through the process of applying resources. In this context, architecture allows the asynchronous elements of institutions and processes to be linked together. Thus architecture creates the basis for institutional agreements to be shared by self-adjusting and resource-integrating actors and value to be co-created through the process of service exchange.

1. Introduction

For two decades now, service-dominant logic (Vargo & Lusch, 2004), (Vargo & Lusch, 2018) and service science (Spohrer & Maglio, 2008), (Spohrer et al., 2019) have been establishing the foundations for a uniform understanding of service, service exchange and how platforms and ecosystems are functioning. This worldview stands in a sharp contrast to the goods-dominant logic of the past: service – as the application of competences for the benefit of another – rather than goods is considered to be the fundamental basis of economic exchange (Maglio, Vargo, Caswell, & Spohrer, 2009; Vargo & Lusch, 2018).

The service-dominant logic (s-d logic) grounding of service ecosystems identifies the core elements of mutual service provision in actor-to-actor networks (Vargo & Lusch, 2016) and is partially conceptualized in terms of institutions for coordinating value co-creation (Vargo, Akaka, & Vaughan, 2017). The view of value co-creation and innovation provided by s-d logic´s ecosystems approach enables oscillation among the micro-, meso- and macro-level perspectives (Chandler and Vargo, 2011; Akaka and Vargo, 2014). “The structure and dynamics as well as the effective value co-creation functioning at the levels of service networks and service ecosystems represent key areas of service research. Understanding the emergence mechanism and the evolutionary dynamics of nested configurations of service systems may be the core interest of a possible general theory of service” (Vargo & Lusch, 2018).

The aspects of “structure”, “dynamics” and “multilevel” perspectives led us to discussions and questions like “how do structures emerge and how they are maintained in this systemic functioning of mutual service provision?” or “how can the oscillations among micro-, meso- and macro-level perspectives be described?”. This motivated our core research question: “How can architecture contribute to value co-creation in service ecosystems?”

To answer this research question, we employed the methodological approach of “theory adaptation” within the common types of research designs of conceptual paper. In addition to the domain theories s-d logic, service science and institutional economics, we draw on structuration theory and social theory to gain new perspectives on our research topic. The findings from these theories are then adapted in the context of answering our research question. Finally, implications for further theoretical research and practical applications are derived from the results and an outlook is given.

2. Methodology

The research design of this paper is aligned to the research goal to demonstrate the impact of architecture for value co-creation in service ecosystems. A conceptual paper as methodology and within this methodology “theory adaption” as approach are chosen (Gilson & Goldberg, 2015). “Theory adaption” seeks to amend an existing theory by using other theories, concepts and logics. The attempt of the “theory adaption” approach is to reach new perspectives on the object of investigation by adapting other theories (Jaakkola, 2020). This paper is based on the domain theories of service-dominant logic (Vargo & Lusch, 2004), service science (Spohrer et al., 2019),

and institutional economy (Scott, 2013), (Ostrom, 1990). Building on the basic concepts and relationships such as service, value co-creation, institutions, actor-to-actor networks, resource integration and service ecosystems the research domain is displayed and the observed gap is demonstrated.

In order to close the gap, further theories have to be consulted, in our paper these are structuration theory (Giddens, 1984) and social theory (Coleman & Coleman, 1994). By providing alternative frames these theories are used to adjust and expand the conceptual scope of the domain theories for answering the research question.

3. Domain theories

Considering contemporary literature on economic exchange s-d logic and service science represent an aggregation of knowledge on value and value creation (Lusch & Vargo, 2014; Vargo & Lusch, 2016; Vargo & Lusch, 2004) based on service exchange. Within this, service acts as the unifying element. According to service science (Kieliszewski, Spohrer, Lyons, Patrício, & Sawatani, 2018; Spohrer & Kwan, 2009) and s-d logic, service is always provided in interaction between different actors and results in a unique value. Following this, service is defined as the application of resources (in particular knowledge, skills and competences) to make changes that have value for another. S-d logic ”[…] is focused on the interaction of the producer and the consumer and other supply and value network partners as they co-create value through collaborative processes” (Lusch & Vargo, 2008). The interactive relationship during value co-creation results in added value that improves one's own state or condition. For the process of value co-creation the integration of resources is a central concept (Peters, 2016), (Vargo & Lusch, 2004). In this process actors are natural or legal entities capable of acting on potential resources and by this carrier of operant and/or operand resources (Löbler, 2013). Operant resources, such as competences, are those that act upon other resources to create benefit; while operand resources are those resources which must be acted on to be beneficial, such as natural resources, goods and money (Constantin & Lusch, 1994; Vargo, Lusch, & Akaka, 2010). For this s-d logic serves as a meta-theoretical framework for explaining the process of value creation through service exchange among multiple resource-integrating actors forming institutionally coordinated service ecosystems (Vargo & Lusch, 2016, 2018).

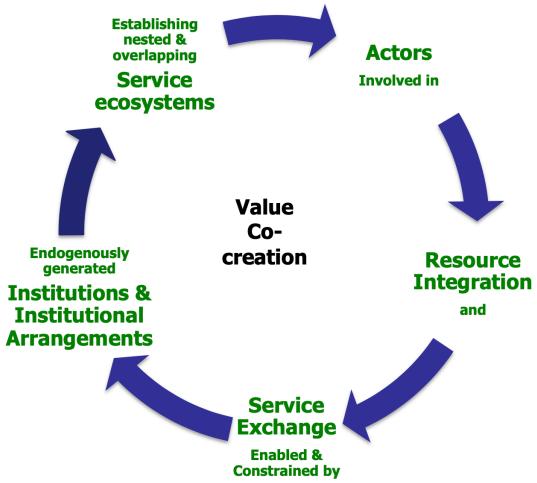

Figure 1 The narrative and process of s-d logic (Vargo & Lusch, 2016)

Based on the new worldview of s-d logic, service science grounds the nature, scientific understanding, management principles and engineering discipline needed to understand and improve service and service innovation (Maglio & Spohrer, 2008; Spohrer, Vargo, & Maglio, 2008). With the service system a new unit of analysis is introduced by service science. Referring to the interactive character of service that involves at least two entities - one applying competence and another integrating the applied competences - these interacting entities are called service systems. More precisely, service systems are defined as dynamic value co-creation configurations of resources, including people, organizations, shared information (language, laws, measures, methods), and technology, all connected internally and externally to other service systems by value propositions (Spohrer, Vargo, & Maglio, 2008). Therefore from service science perspective service ecosystems can be described as a structure of interconnected service system entities.

Moving toward a general theory of service (Spohrer, Fodell, & Murphy, 2012; Vargo, Akaka, & Vaughan, 2017), five distinctive characteristics of service ecosystems are defined (Vargo & Lusch, 2018):

- service ecosystems are relatively self-contained and have fuzzy boundaries,
- actors are relatively self-adjusting, as they show adaptive behaviour,
- actors are resource integrators that overcome the traditional view of enterprises too much focused on their internal resources and their mono-directional approach 'to' market,
- actors are connected by shared institutional logics,
- service exchange in service ecosystems results in mutual value creation.

These characteristics demonstrate that service and service ecosystems are intrinsically systemic and dynamic concepts. The most significant evidence of this systemic functioning is that it is emergent and does not necessarily require top-down government and control mechanisms like in the case of planned networked organizations (Vargo & Lusch, 2018). This emergent actor-to-actor orientation also implies that the

resources used in service provision typically, at least in part, come from other actors (Vargo & Lusch, 2016). In the context of actor coordination and service exchange s-d logic has clarified the understanding and role of institutions as routinized, coordinating mechanisms, and becoming essential to understanding value co-creation: “As actors within a service ecosystem are cognitively distant from each other, shared institutional arrangements are necessary in order to coordinate their otherwise unrelated behaviour (Axiom 5)”(Vargo & Lusch, 2018). Institutions are the human-made rules, norms and beliefs that provide stability and meaning to social life by constraining and enabling collective action (Scott, 2014). They can be understood as the implicit and explicit ‘rules of the game’ (Milgrom, North, & Weingast*, 1990), which coordinate resource integration and service exchange among actors (Edvardsson, Kleinaltenkamp, Tronvoll, McHugh, & Windahl, 2014; Vargo & Lusch, 2016).

With her research and studies, Ostrom developed a broader theory of institutional arrangements related to the effective governance and management of common-pool resources (Ostrom, 1990). One recognition was that society and its rules (institutions) are designed to optimally transform resources into goods, not how to preserve or increase commons. As a consequence the design of the institutions themselves is seen as the craft of long-term process design which requires the involvement of actors (Ostrom & Helfrich, 2012). With her research and the resulting design principles, Ostrom has shown that it is possible to treat resources by using appropriately designed institutions in a way that they become more when they are shared (Ostrom & Helfrich, 2012).

In conclusion, the systemic functioning of value co-creation and service ecosystems can be grounded, demonstrated and analysed on the basis of the domain theories s-d logic, service science and institutional economics. The idea of resource networks contributes to the understanding of value creation, its consideration sometimes lacks a critical characteristic of systems, which are dynamic and potentially self-adjusting and thus simultaneously functioning and reconfiguring themselves. “That is, each instance of resource integration, service provision, and value creation, changes the nature of the system to some degree and thus the context for the next iteration and determination of value creation. Networks are not just networks (aggregations of relationships); they are dynamic systems” (Vargo & Lusch, 2011). In this context of dynamic systems the aspects of how structures arise as well as the effective value co-creation functioning at the different micro-meso-macro levels of service networks and service ecosystems (Vargo & Lusch, 2018), still represent key areas of service research. And by this led us to our research question “how can architecture contribute to value co-creation in service ecosystems?”

On this basis, in the next step we seek to amend the domain theories by using theories and logics of structuration theory and social theory.

4. Theories adapted

With the help of additional theories, the still lacking aspects are to be explained enhance the existing domain theories by new perspectives. In this context the aspects of how structures arise are analysed by drawing on structuration theory. Architecture creates the prerequisites of value co-creation by facilitating the interaction of actor engagement, institutions, and (design) patterns. New insights into the functioning of

value co-creation at the different micro-meso-macro levels should be extracted from social theory.

4.1. Structuration Theory

Structuration theory is a concept explaining human behaviour based on a synthesis of structure – and agency effects (Gibbs, 2011; Giddens, 1984; Whittington, 2010) (Whittington, 2010).

The structure theory considers the behaviour of humans to be significantly influenced by existing structures. Structure can be advantageous in the sense of stability and security (Durkheim, 2014) or disadvantageous in that the existing structures prevent the change to more justice (Marx, 2016). In contrast to this is agency theory, which sees individuals in a position to implement their own free will and decisions. In this way, according to agency theory, structures emerge from the actions of individuals (Sewell Jr, 1992).

Giddens questioned the polarized nature of structure and agency theory. He argues that through the way individuals acting is influenced by structure, structures are maintained and fostered: the "duality of structure" describes that „the structural properties of a system are both the medium and the outcome of the practices they recursively organize" (Giddens, 1984). This results in the understanding of structuration as conditions governing the continuity or transmutation of structures, and therefore the reproduction of social systems (Giddens, 1984).

Structures therefore provide a pattern to social relations: "Structure appears as external to human action, as a source of constraint on the free initiative of the independently constituted subject" (Giddens, 1984). Giddens identifies three dimensions of structures in social systems (Giddens, 1984): First "signification" where meaning is e.g. coded in practice of language. Second "domination" concerned with political institutions of how power is applied e.g. control of resources. Third "legitimation" as legal institutions embedded in normative regulation and societal norms and values.

Structure hence emerges as a kind of "virtual order" means that social systems, as reproduced social practices, do not have structures but rather exhibit structural properties. Structure is seen as rules and resources, or sets of transformation relations, organized as properties of social systems. And that "… structure exists, as time space presence, only in its instantiations in such practices" (Giddens, 1984). Resources are media through which power is exercised, as a routine element of the instantiation of conduct in social reproduction. Power within social systems which enjoy some continuity over time and space presumes regularized relations of autonomy and dependence between actors or collectivities in contexts of social interaction.

Applied to service ecosystems the understanding of structure and its transformation can be transferred from structuration theory: Actors are not only humans but all entities, institutions as rules and the process of value cocreation as social action. Thus, structuration theory creates helpful implications and mechanisms to explain the formation and maintenance of structures. Structures can arise as a "virtual order" and are instantiated by the exercise of rules and resources; they are maintained by the re-production of practices; and apply across space and time in which they develop.

4.2. Social theory

To address and explain the relation and interdependencies of large-scale things, a differentiation between the macro level, like social events or organizations to smaller-scale things, and the micro level, like individual behaviour, is of relevance. To demonstrate the relevant mechanisms, Coleman´s boat (Coleman & Coleman, 1994) is one of the most famous approaches (Ylikoski, 2016). It provides a systematic way to think about the macro-micro relations and by this, to understand the impact, interaction, and relations between micro and macro actions and interactions (Felin, Foss, & Ployhart, 2015).

Storbacka et al. (2016) use elements of social theory for observing and analyzing value co-creation. Referring to Coleman´s boat and insights of the microfoundation movement (Barney & Felin, 2013; Felin, Foss, & Ployhart, 2015), Storbacka et al. (2016) underline that macro-macro level explanations can be lacking in explanatory power.

Therefore, Storbacka et al. (2016) anchor and reveal the causes of the more abstract macro (ecosystem and institutional logic) concept of value co-creation with micro (actor engagement) and meso (sets of actors and their resources, e.g. organization) level mechanisms.

As illustrated in Figure 1, institutional logic on macro level forms the meso level conditions and context for actors to engage with their resources on engagement platforms (arrow 2) and influences by this the disposition of the actor (arrow 3). This leads to a change in actors' disposition and to engagement activities that can be characterized by observable engagement outcomes (arrow 4). The engagement of many actors leads to the emergence of various resource integration patterns (arrow 5); on the meso level the resource configurations of the actor are transformed which leads to value co-creation (arrow 6) (Storbacka, Brodie, Böhmann, Maglio, & Nenonen, 2016).

By exploring the relevance of individual actor engagement on micro level in service for service exchange, Storbacka et al. (2016) show actor engagement as a microfoundation for value co-creation.

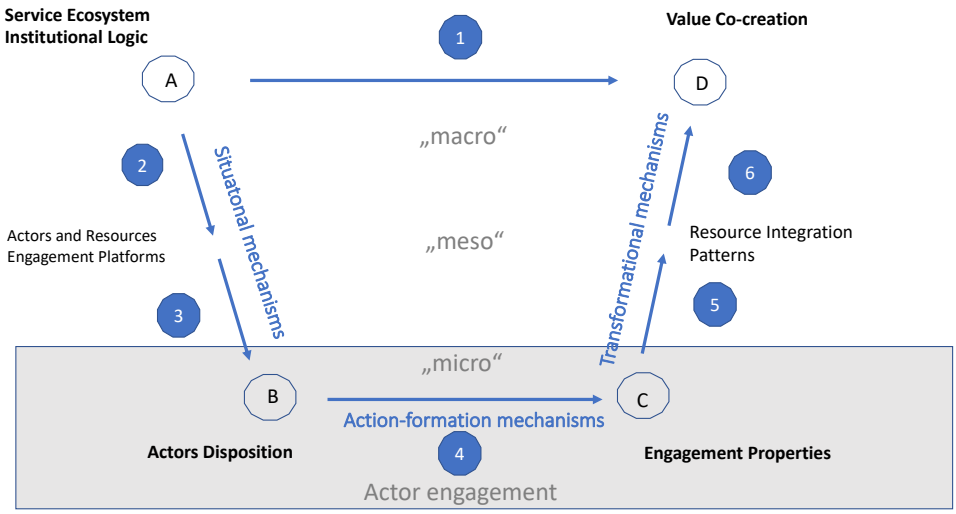

Figure 2 Coleman´s boat differentiated by Storbacka et. al. 2016

The meso-level plays a key role in the micro–meso–macro explanation that links the micro-level process of actor engagement with the macro-level of value co-creation. Core of the transformational mechanisms are resource integration processes at the meso-level in which new properties are generated.

Service ecosystems arise at the macro-level (Storbacka, Brodie, Böhmann, Maglio, & Nenonen, 2016) if the resource integrating actors are connected by shared institutional agreements and mutual value creation (Vargo & Lusch, 2018).

In this way social sciences can be used for analyzing and describing the functioning of value co-creation at the different micro-meso-macro levels. By changing situational mechanisms individual engagement is initiated on the micro-level. On the meso-level sets of actors and their resources are engaged and contribute to the emergence of structures by initiating pattern ("virtual order"); thus unconsciously by just action or consciously by design.

This is how resource integration patterns are created, which enable the exchange of resources and service and as transformation mechanisms explain the emergence of the macro-level process of value co-creation.

5. Why architecture matters

Coming back to our research question "how can architecture contribute to value co-creation in service ecosystems?" we now consider the role of architecture. Architecture is understood as both the process and the product of planning, designing, and constructing buildings or other structures (Alexander, 1977; Gamma, Helm, Johnson, & Vlissides, 1995).

To analyse the role of architecture in the process of value co-creation in service ecosystems, we first map the key terms of the process of value co-creation with the core characteristics of architecture.

Key terms of value co-creation	Links to structure and architecture	Theories
Actor engagement	Actor as carrier of operant and/or operand resources. Situational engagement of individual actors (micro); transformational engagement of sets of actors (meso); value co-creation (macro)	Microfoundation, Colemans boat (social theories, s-d logic, service sciences)
Institutions and institutional agreements	Rules drawn upon (standards, laws, contracts, tools)	Institutions and institutional agreements, multi-level-foundation (social

		theories, institutional economics, service-dominant logic)
Research question: emergence of structure?	Structure emerges as "virtual order" or pattern with structural properties. Design of pattern as applicable solutions to the problem (commonly accepted)	Virtual order, pattern, structural properties (structuration theory, social theory, design science research methodology, architecture)
Actors involved in resource integration and service exchange	Virtual order, structural properties, resource integration pattern and material structures as result from application of rules and resources in the process of resource integration and service exchange	Service exchange, virtual order, pattern, structure (s-d logic, service science, institutional economics, structuration theory, social theories)
Research question: maintenance of structure?	Structure "instantiated" as material presence through application of rules and resources by an entity	Structuration theory, Service-dominant logic, service sciences
Establishing service ecosystems	Structure as material presence in time and space through self-adjusting and recurring application of rules and resources by resource-integrating actors	Service-dominant logic, service sciences

Table 1 Architecture as facilitator of the "duality of structure"

Table 1 shows that there are multiple links between the process of value cocreation and the process of architecture. Both processes are initiated by actors involved in planned or unplanned activities.

Architecture facilitates the emergence and maintenance of structure in the context of the process of value cocreation out of two perspectives. First, architecture enables structure as kind of intangible, virtual order or (design) pattern of social relations or in context of service ecosystems of actor relations (Alexander, 1977; Giddens, 1984). Second, structures reinforce themselves based on architectural choices as material presence instantiated by the application of rules and resources.

By linking institutional arrangements with (design) pattern architecture enables the involvement and coordination of actors in the entire and organized process. For example by the definition of rules, tools or formats for service exchange. This both in the process of planning and designing of structures as architectural pattern and in the process of physical resource integration and instantiation of the material.

In reciprocation, the institutions themselves become part of the design process (Ostrom, 1990). This makes possible to operationalize design principles relevant for

successfully sharing and developing resources like “congruence between appropriation and provision rules and local conditions”, “collective choice arrangements”, “monitoring”, “sanctions” or graduated conflict mechanisms” (Ostrom, 1990, 2009).

By combining institutional agreements with “virtual order” as (design) pattern the asynchronous elements of institutions and the process of actor engagement as application of resources are linked. The output of this combination of institutions and pattern is comparable to a value proposition which is both an outcome and a medium of value cocreation. Therefore the combination can be seen as a prerequisite for the tangible process of resource integration and service exchange. Thus architecture creates the basis for institutional agreements to be shared by self-adjusting and resource-integrating actors and value to be co-created through the process of service exchange.

Referring to Giddens “duality of structure”, this duality can be called the "duality of architecture". Architecture as material outcome of value cocreation and service exchange and as pattern as medium of value cocreation. With the help of social sciences the role of architecture in the functioning of the process of value cocreation at the different micro-, meso-, macro-levels can be unpacked (Storbacka, Brodie, Böhmann, Maglio, & Nenonen, 2016). Driven by situational mechanisms actor engagement in the application of pattern as applicable solutions is generated on the micro-level. As described the meso-level plays a key role for the micro-meso-macro explanation by linking the micro-level to the macro-level of value cocreation.

6. Implications for practice

We inform about a longitudinal case study of (design) pattern combined as an architectural framework derived from Service-Dominant Logic and Service Science (Warg, Weiß, Engel, & Zolnowski, 2016; Weiß, Zolnowski, Warg, & Schuster, 2018).

In order to meet the key elements (Table 1) of value co-creation (actor engagement, institutions, resource integration, service exchange, service ecosystem) in actor-to-actor networks, the approach of Service Dominant Architecture defines a) a conceptual framework as a virtual order or design patterns of four systems plus a set of institutional agreements; which become b) structure of systems and service systems by being instantiated through one or more entity, e.g. on a technological platfom.

6.1. An architectural foundation in practice

In the following, the SDA (design) patterns of the four systems are introduced (Warg, Weiß, Engel, & Zolnowski, 2016; Warg, Weiß, & Engel, 2015):

1. *System of Operant Resources*: The system of operant resources is the heart of the SDA architectural framework. It represents the workbench, where the various resources are brought together and processed. For this, this system applies certain logics or processes. In line with S-D Logic, the focus is on intangible resources, previously defined as operant resources (like competence, knowledge, skills, software

code), are used and brought together to create customer-centric value propositions. These value propositions are dependent on the achievable level of resource density by this system: a high resource density positively impacts the emergence and creation of innovative and relevant value propositions.

2. *System of Interaction*: The system facilitates value in use and value in context by enabling the application of resources bundled in value proposition. Interaction enables resource integration and service exchange between actors e.g. provider and the customer.

3. *System of Participation*: The concept of co-creation includes other actors as co-producers of the value proposition. In this process the system of participation enables actor-to-actor orientation and the participation of other actors by coordinating actors and the process of resource integration.

4. System of Operational Data Stores (*Data Lake)*: From an actors (e.g. organization) point of view, data received and generated by interacting with other actors (e.g. customer) should be systematically recorded and evaluated in real time. In this way, the actor (e.g. organization) can continuously build up data and knowledge about the preferences and the context of other actors like customers. Data based understanding of the customer, their contexts, preferences and needs arises. On this basis, an e.g. organization is able to build customer centric capabilities and value propositions.

5. Set of Institutional Agreements: As rules, institutions enable the coordination of actors and the access to and use of resources. In conjunction with design pattern, institutions enable the planned creation of solution designs for concrete challenges; for implementation, institutions serve as incentives (or constraints) for the engagement of actors, the integration of resources and the material instantiation of service systems.

The (design) patterns as architectural framework of SDA are summarized in the following figure.

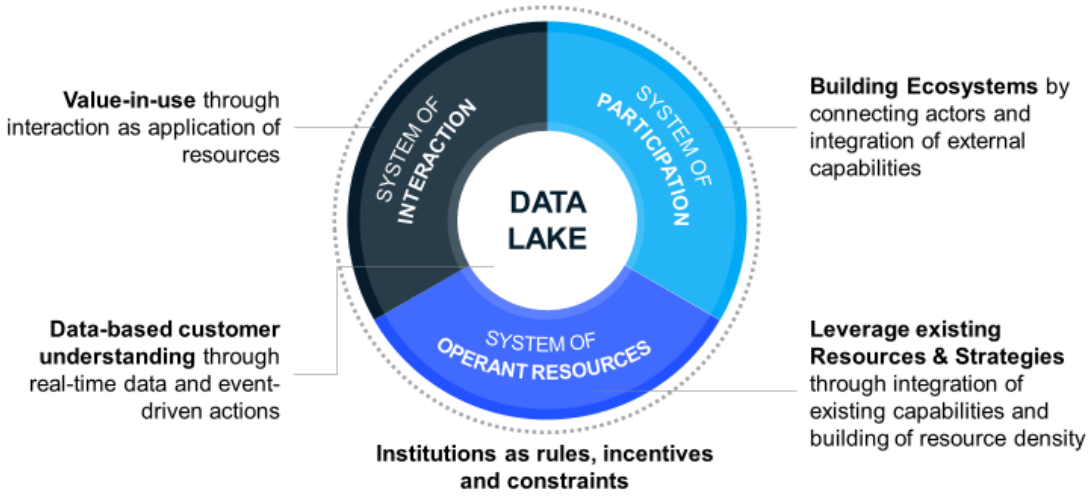

Figure 3 Architectural Pattern as Conceptual Framework of Service Dominant Architecture (source: IfSD.hamburg)

SDA architectural framework enables the value co-creation process first on the level of “virtual order” as design pattern and then as material instantiation by engaging in service exchange. By this the design patterns are "animated" with operand and operant resources and become service systems that create mutual value.

The purposeful building of capabilities is facilitated by enabling the integration and orchestration of resources and setting the institutions for participation and coordination. For this, the SDA framework enables to capture (integration, participation), exchange (interaction), and orchestrate relevant resources in a meaningful way.

6.2. A practical example in healthcare

The example of health is illustrated in figure 4. The basic elements and their functions are agnostic, the instantiation depends on the institutional arrangements. For example, setting the health ID as a norm, incentive and constraint for connecting actors in the health care system. Actors can be e.g. doctors, hospitals, insurance companies, pharmacies, start-ups and patients. A unique health ID as identifier for doctors or health facilities enables actor-to-actor networks and the process of service exchange. Through the application of this norm more and more actors can join this network.

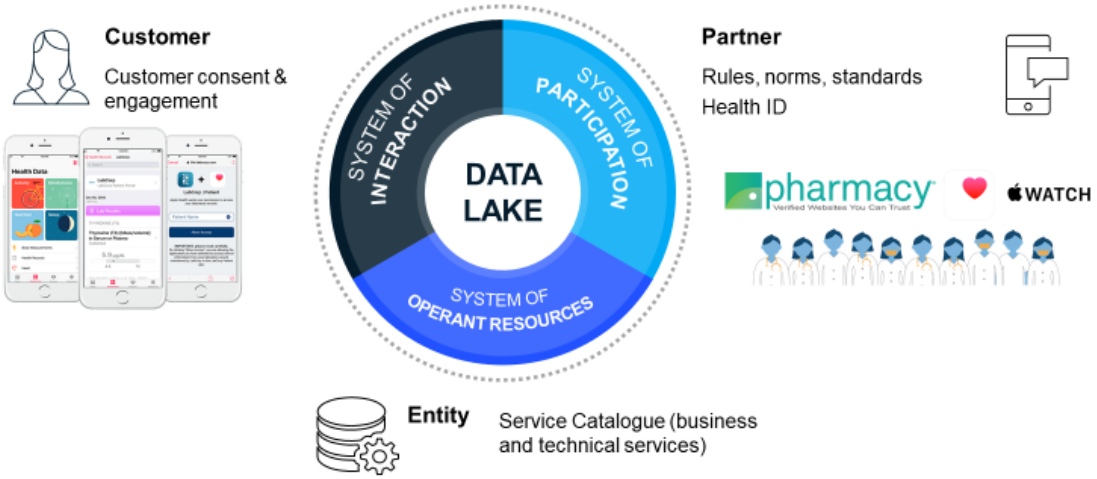

Figure 4 SDA – linking Institutions and Design Pattern (source IfSD.hamburg)

Instantiated by an entity in a given context – e.g. health, figure 4 – this application of the combination of institutions and (design) patterns leads to the emergence of material service systems as configurations of resources that interact with each other to create value. Implemented by an organization, the SDA intends to be a system of systems facilitating much more than its parts by leading to enhanced emergence, fulfilling capability demands and enabling value co-creation between different actors (Boardman & Sauser, 2006). The implementation in practice usually takes place in three steps: first the technical platform is configured (microservices, cloud-agnostic), then generic industry solutions for standard core processes are implemented and fi-

nally only the elements that make the difference in the strategic positioning are specifically realized – figure 5 - (Warg & Engel, 2016; Warg, 2018a, 2020, 2018b; Weiß, 2019).

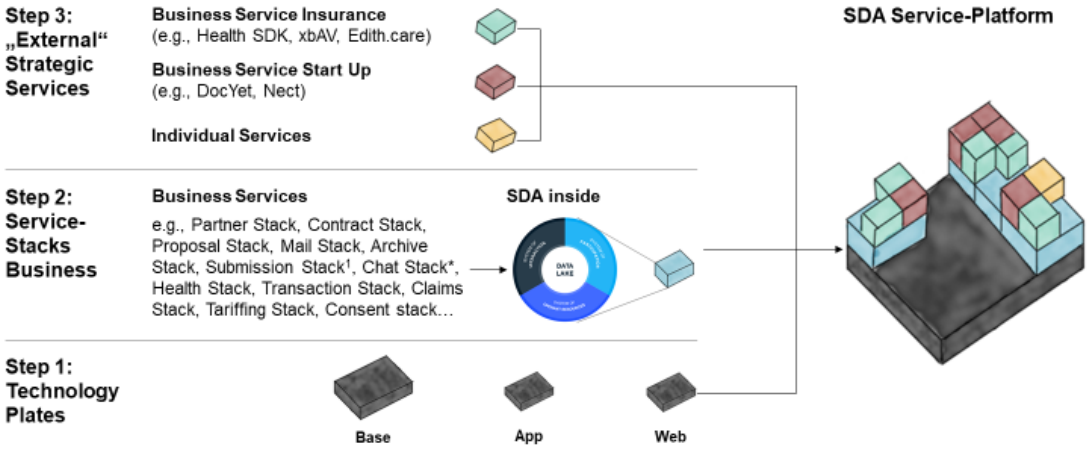

Figure 5 Instantiation on a Service Platform (source: SDA SE)

The results of this research will influence the practical design of the SDA in two areas. In accordance with the great importance of the institutions for the coordination of the actors, their implementation as a set of rules (service catalogue, API, technical formats...) will become even more relevant. In response to the emergence and maintenance of structure, the SDA approach will be even more consciously divided into the design phase (virtual order, design pattern) and the instantiation phase.

7. Implications for research

For researchers, a multi-level architectural view of value co-creation enables a better understanding of the interplay of actors at different levels, institutionalization processes and the emergence and maintenance of structure.

The further differentiation of institutionalization processes on micro-, meso- and macro-level is a manifold research topic. The findings will contribute to a better understanding of the emergence and maintenance of structures in service ecosystems.

In summary the paper demonstrates that architecture is highly relevant to the process of value co-creation and the emergence and maintenance of structure in service ecosystems.

8. Conclusions and outlook

This paper analyses and demonstrates the contributions of architecture to value co-creation in service ecosystems. This shows the multiple links between the process and output of value co-creation and the process and output of architecture.

Architecture facilitates the emergence and maintenance of structure in the context of value co-creation out of two perspectives. First, architecture enables structure as

kind of intangible, virtual order or (design) pattern of social relations or in context of service ecosystems of actor relations. Second, architecture facilitates structure as material presence instantiated by the application of rules and resources referring to the logic of the design pattern.

By linking the asynchronous elements of institutional arrangements with (design) pattern and actor involvement architecture enables the involvement and coordination of actors in service exchange. Thus architecture is both the medium and the outcome of the practices of value co-creation.

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