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Abstract

The rapid advancements on digital technologies have positioned digital transformation as a central topic of interest to information systems (IS) researchers. However, our understanding of the nature, extent and dynamics of digital service ecosystems remains limited. This short paper contributes to IS and service science research by introducing the conceptualization of self-organizing service ecosystem as an analytical lens for understanding digital transformative phenomena in service ecosystems. To achieve this, we draw on the most recent narrative of value co-creation from service-dominant logic and on key definitions from the theory of self-organization. This paper also discusses future research directions emphasizing on the role and impact of technology in self-organizing service ecosystems.

Keywords self-organizing, service ecosystems, digital transformation, service-dominant logic, fintech

1 Introduction

Digitization is affecting every sector of every economy (Rai 2016). For example, in the case of financial services, new offerings like crowdfunding (e.g., GoFundMe) or peer-to-peer (P2P) lending (e.g. LendingClub) are two areas where information systems (IS) led to the rise of financial technology or 'Fintech' (Breidbach and Ranjan 2017). However, while digital transformation has been a topic of interest to IS researchers for a long time (Agarwal and Lucas Jr 2005), our understanding of the factors that enable the emergence of new digital service ecosystems like those prevalent in Fintech remains limited (Lusch and Nambisan 2015). For one, the conceptual boundaries of digital transformation itself are poorly understood (Nambisan et al. 2017), which makes it necessary to adopt novel research designs; for example through macro-lenses on digital transformation (Agarwal and Lucas Jr 2005), by deemphasizing the prevailing focus on IS artefacts (De Sanctis 2004), by utilizing theoretical lenses stemming from other disciplines (Rai 2016), or by adopting new research methods (Antons and Breidbach 2018). In fact, increasing the impact of IS research associated with digital transformation (Agarwal and Lucas Jr 2005) is such a significant challenge for our discipline that Rai recently called for future work to "be at the forefront of knowledge creation pertaining to transformative digital phenomena" (2016, p. v), especially as they pertain to the service sector (Rai 2016, p. iv). Here, we contribute to this challenge.

In the broadest sense, our short conceptual paper contributes to the discourse associated with the digital transformation of service firms in the IS and service science literature by developing and introducing the novel concept of self-organizing service ecosystems. Self-organizing service ecosystems are able to emerge, adapt, and evolve in the absence of any external impositions. We argue that self-organizing service ecosystems represent a novel conceptual lens that addresses the challenges currently associated with IS research related to digital transformative phenomena: self-organizing service ecosystems provide the much-needed macro-lens (Agarwal and Lucas Jr 2005), deemphasize the focus on IS (De Sanctis 2004), and accomplish this by building on self-organization theory (Haken 2006) and service science (Vargo and Lusch 2017), both of which stem from outside the IS discipline (Rai 2016). As such, our present work offers three distinct contributions to IS scholarship.

First, by developing and introducing self-organizing service ecosystems in the IS literature, we provide a new concept and terminology to study digital transformative phenomena in service contexts more broadly. Our present work relies on a mid-range theorizing approach (Vargo and Lusch 2017), which integrates self-organization theory (Haken 2006) with digital transformation research, and uses Fintech as our contextual setting. As such, we address gaps in knowledge related to the understanding of technology-enabled multi-actor service ecosystems highlighted in both, the service science (Ostrom et al. 2015; Vargo and Lusch 2017) and the IS literature (Lusch and Nambisan 2015; Nambisan et al. 2017). In addition, the Fintech context is uniquely suited for our research approach due to its complexity, IS-dependency, and transformative potential in reshaping the financial service industry more broadly.

Second, we outline the characteristics of self-organizing service ecosystems in a coherent conceptual framework, which is capable of explaining the societal and technological transformations driven by IS more generally. Our framework offers new insights into how IS, like those enabling Fintech platforms, may facilitate and transform value cocreation in service ecosystems (Storbacka et al. 2016), which addresses current gaps in knowledge related to the still limited understanding of technology in value cocreation (Ostrom et al. 2015), and especially in the context of technology facilitating the integration and coordination efforts required in complex service settings that consist of multiple actors and networks (Bharadwaj et al. 2013). Our third, and final contribution, stems from future research opportunities at the intersection of IS and service science.

This paper is organized as follows: first, we delineate a framework consisting of five characteristics underpinning self-organizing service ecosystems and, second, demonstrate its theoretical applicability using Fintech as a context. Finally, we discuss our findings and future research directions resulting from this perspective.

2 Characterizing Self-Organizing Service Ecosystems

Service-dominant (SD) logic (Vargo and Lusch 2008) is an evolving metatheoretical framework differing from the firm-centric, goods-dominant (GD) logic. It positions all economic activity as a service – for – service exchange and considers all interacting actors as co-creators of value (Vargo and Lusch 2008). SD logic introduced the service ecosystem concept into the Marketing discipline, and defined it as "system[s] of resource-integrating actors connected by shared institutional logics and mutual value creation through service exchange" (Vargo and Lusch 2016, p. 161). Although this definition is increasingly used in IS research (Breidbach and Ranjan 2017; Lusch and Nambisan 2015), in-depth explorations of its underlying premises are scarce. Specifically, the underlying characteristics of self-containment and self-adjustment that Vargo and Lusch (2017) mention have only been referenced by Storbacka et al. (2016) to date. Here, we argue that exploring the self-organizing nature of service ecosystems (i.e., its self-containment and self-adjustment), is a fundamental prerequisite when examining the role and impact of technology within service ecosystems (Nambisan and Sawhney 2011; Storbacka et al. 2016; Vargo and Lusch 2016; Vargo and Lusch 2017). This is because self-organization provides an analytical lens that focuses on the integration and coordination efforts required for dealing with multiple actors, networks, and processes - common consequences of technology-infusion in service (Bharadwaj et al. 2013; Breidbach and Maglio 2016). Understanding the processes and mechanisms of self-organization in service ecosystems is therefore a key enabler to gain a better understanding of digital transformative phenomena in IS research, the orchestration of value co-creation (Breidbach et al. 2016), but also for improving the still limited understanding of the role of technology in value cocreation (Ostrom et al. 2015).

Understanding the characteristics of self-organizing service ecosystems is a significant research problem, requiring interdisciplinary research (Rai 2016). Here, we draw on insights from self-organization theory, which has already been applied in physics (Haken 1977), computer science (Musil et al. 2015), management (Coleman 1999), and the social sciences (Fuchs 2006). Taking from literature dedicated to self-organization theory, Table 1 provides an overview of existing definitions of self-organizing systems. We highlight key characteristics.

Definition of Self-Organizing System	Key Characteristic
"A system is self-organizing in the sense that it changes from 'parts separated' to 'parts jointed'… changing from a bad organization to a good one" (Ashby 1962, pp. 266-267).	Local interactions, emergence
"Complex adaptive systems that display emergent behaviour" (Johnson 2002, p. 18).	Complexity, emergence, adaptiveness
"A system is self-organizing if it acquires a spatial, temporal or functional structure without specific interference from the outside… meaning that the structure or functioning is not impressed on the system, but that the system has acted upon from the outside in a nonspecific fashion" (Haken 2006, p. 11).	Emergence, distributed control
"System properties emerge due to the local interactions among the elements, without any external command, so the mechanism is called self-organization" (Erdi 2008, p. 19).	Local interactions, emergence, distributed control
"Self-organizing systems… change their internal structure and their function in response to external circumstances… elements of a system are able to manipulate or organize other elements of the same system in a way that stabilizes either structure or function of the whole against external fluctuations" (Banzhaf 2009, p. 2).	Adaptiveness, distributed control

Table 1. Characteristics of Self-Organizing Service Ecosystems

By identifying and exploring the characteristics of self-organization, we are able to refine the understanding of service ecosystems more broadly, and align the emerging discourse stemming from Marketing research with the IS discipline. In what follows, we analyze each characteristic of self-organizing service ecosystems (complexity, emergence rising from local interactions, adaptiveness and distributed control). Following suggestions by (Vargo and Lusch 2017), we accomplish this by using a mid-range theorizing approach, which bridges theory and practice by applying the meta-theories of self-organization to the empirical context of Fintech services.

Complexity

Self-organizing service ecosystems are complex because they (1) have multiple elements; (2) are nested systems; and (3) their elements display nonlinear interactions due to feedback loops (Ashby 1962; Banzhaf 2009; Johnson 2002). The service science literature already characterizes service ecosystems as complex (Spohrer et al. 2007), however, it does not specify how individual components of complex systems are embedded in service ecosystems, nor how digital technology is affecting individual components. We now address this shortcoming.

Digitally-enabled service platforms like LendingClub allow previously disconnected economic actors to build, and interact via a digital service ecosystem. With its 2 million users that perform roles of borrowers and lenders (LendingClub 2018), it is evident that the service ecosystem underpinning LendingClub satisfies the first criteria of complexity. Furthermore, an individual user can simultaneously engage in multiple loan transactions, thus creating multiple, overlapping, and nested service ecosystems, thus satisfying the second criteria characterizing a complex system. Fast database techology allows easy tracking of these interactions. Finally, the service ecosystem displays non-linear dynamics due to feedback loops. Feedback occurs both (1) between actors on both lending and borrowing abilities and honesty, and (2) between actor and service ecosystem levels, as LendingClub changed the loan portfolio composition due to high levels of default in high risk loan categories. In this sense, feedback could take the form of institutions (rules, norms, practices, beliefs) and institutional arrangements (sets of institutions) (Vargo and Lusch 2016). This feedback is facilitated by modern social network infrastructure such as slick user interfaces, fast communications, and database back-ends. Thus, a service ecosystem fulfills the three key characteristics of a complex system.

Local Interactions and Emergence

The second and third characteristics of self-organizing service ecosystems are the emergence of a self-organizing system that cannot be understood by aggregating the independent behavioural patterns of actors in the system, but must be analyzed by focusing on the interactions between each actor (Helbing 2012). Thus, we now demonstrate that service ecosystems have interactions amongst its actors, leading to the emergence of value cocreation processes and new service ecosystem's structures.

SD logic, states that "value is co-created by multiple actors, always including the beneficiary", and that "actors cannot deliver value but can participate in the creation and offering of value propositions" (Vargo and Lusch 2016, p. 8). Both SD logic and self-organization theory define value as a property that is emerging from the interaction of actors, rather than created by a single actor. In the context of P2P lending platforms, local interactions occur as individual lenders and borrowers interact through resource exchanges underpinning loan transactions. These interactions enable access by either investors or borrowers to value in terms of loan transactions; monetary returns for investors; and lower-interest loans for borrowers (Emekter et al. 2015; LendingClub 2018). Throughout this process, LendingClub facilitates interactions by matching borrowers with lenders, with borrowers requesting loans from lenders, and lenders making loan offerings while determining repayments and interest rates. So we see that it is almost by definition that service ecosystems have the emergence property, thus making them self-organizing systems.

Adaptiveness

The fourth characteristic of a self-organizing service ecosystem is adaptiveness. Self-organizing service ecosystems adapt to their changing environment by altering, stabilizing and manipulating its internal structure and functioning (Heylighen 2001). This is achieved through the use of local rules (Johnson 2002), and positive and negative feedback loops (Helbing 2012). By integrating self-organization theory and SD logic, it is evident that a self-organizing service ecosystem is able to adapt to a changing environment as it self-adjusts in structure and ability to cocreate value.

Local interactions and feedback loops are fundamental for the adaptiveness of the self-organizing service ecosystem. First, local interactions among actors enable feedback loops that stimulate each actor to adjust its behaviour, role, and resource integration patterns. Second, feedback loops occurring between the system level (macro-level) and the actor level (micro-level) influence the adaptiveness of the self-organizing service ecosystem. Self-organization theory calls this feedback cycle between the macro and micro levels: circular causality. Institutions and institutional arrangements at the macro-level coordinate actors (micro-level) in such way that actors modify their own institutions and institutional arrangements related to roles and resource integration activities for adapting to a changed value co-creation process. Here, the service ecosystem is then an organizing logic of the value cocreation process (Lusch and Nambisan 2015). Closing the feedback cycle, institutions generated at the actor level (micro-level) can contribute to shaping the institutions and institutional arrangements governing the service ecosystem (macro-level).

Technology is accelerating the adaptiveness and evolution of self-organizing service ecosystems. For example, the digital platform of LendingClub allows investors to restructure their investment portfolio by changing the investment criteria used to diversify it, and enabling selling and buying of loans at anytime depending on their financial goals (LendingClub 2018). This means that service ecosystems nested within the service ecosystem could easily form and reform while continuing to cocreate value. Hence, service ecosystems satisfy this requirement for self-organization. Additionally, this provides a new perspective into advancing knowledge on the emergence and evolution of institutions and institutional arrangements in value cocreation and on the role of technology facilitating the service ecosystem adaptiveness.

Distributed Control

Finally, the fifth characteristic of self-organizing service ecosystems is the absence of external impositions on its structure or overall functioning. Instead, any outcomes result from interactions and resource integration activities of actors within the ecosystem. In this sense, the notion of control over structure fulfils two purposes. First, control is distributed across all actors within the ecosystem. Second, control is not imposed by an external entity, so that any value cocreating activities emerge from the actors themselves (Vargo and Lusch 2016). In the context of financial services, any value cocreating interactions are bound to heavy government regulations, rigid structures, and a slow pace of technology adoption. In fact, banks represent central actors who conduct the interactions of others with themselves, rather than allowing other actors in their service ecosystems to interact and integrate resources directly. In contrast, Fintech platforms possess a stronger ability to facilitate interactions between others due to less regulation and high centrality of technology-use. For example, Bitcoin operates on a distributed ledger with a decentralized structure where all changes have to be verified using consensus-based approaches without the need for transactions to be validated by a single actor such as a bank (Böhme et al. 2015). The structure and value cocreating processes changed considerably as actors participate in, validate, and broadcast transactions by interacting without the need of a central actor. P2P lending platforms also exhibit decentralized structures since the initiation and execution of loan transactions are completed by interdependent borrowers and lenders. Each of these actors have more control over how their resources are integrated for value co-creation. Enabled by technology, self-organizing service ecosystems display functions and structures that emerge from local and dynamic, instead of, rigid and centralized interactions.

We see, therefore, by examining the tenants of SD logic, and examples from the Fintech setting, that service ecosystems can fulfil the key requirements to be self-organizing systems: complexity, emergent behaviour from local interactions, adaptiveness and distributed control.

3 Discussion, Conclusion and Future Research

Our short paper developed and introduced the concept of self-organizing service ecosystem into the IS and service science literature. We demonstrated that previous conceptualizations of service ecosystems common in Marketing (Vargo and Lusch 2008), and increasingly used in IS research (Barrett et al. 2015; Breidbach and Ranjan 2017), are limited in their explanatory power of digital transformative phenomena due to the absence of understanding on how these systems emerge, manage, and regulate themselves (e.g., self-organize). We used a midrange-theorizing approach and applied self-organization theory to identify and explain the characteristics of complexity, adaptiveness, as well as distributed control, local interactions and emergence; therefore, extending the notion of service ecosystem from Vargo and Lusch (2016). Our paper paves the way to understanding the complex dynamics, characteristics, and value-creating processes of service settings IS researchers are increasingly interested in (Rai 2016), while linking existing theories and disciplines - self-organization theory and IS - thus broadening the scope of thinking in IS research (Gilson and Goldberg 2015).

Self-organization in service ecosystems prompts future research on how technology empowers and guides the nature of service. Specifically, we envision for self-organizing service ecosystems to emerge as a useful conceptual lens for research at the intersection of IS and service science, and especially for understanding digital transformative phenomena. Technological developments trigger societal transformations at an unpredictable rate and scope, thus requiring new lenses, terminology and concepts to overcome challenges in traditional IS approaches that lacked impact to date (Agarwal and Lucas Jr 2005). For example, P2P platforms in the context of financial services enable disconnected economic actors to engage in service transactions previously controlled by, and only accessible through, large financial institutions. It is undisputed that the emergence of new digital technologies has accelerated the formation and reformation of self-organizing service ecosystems. Thus, our conceptualization of self-organizing service ecosystems sets the stage to address existing knowledge gaps pertaining to the impact of technology on the structure and functioning of service ecosystems (Nambisan et al. 2017; Vargo and Lusch 2017).

While the benefits commonly associated with the formation of service ecosystems more broadly range from reduced cost for service customers to higher operational efficiency for firms (Breidbach et al. 2018; Lusch and Nambisan 2015), self-organizing systems can also get caught in a non-optimal configuration or functioning (Heylighen 2001). This is because the process of self-organization does not necessarily guarantee optimal results (Helbing et al. 2009). For instance, non-optimal structural configurations could be triggered by delayed or non-existent responses by actors in the system due to their limited processing capacity (Helbing 2012). To overcome this problem, Prokopenko (2009) refers to guided self-organization, and suggests this may be achieved either through signals that define desirable behavior to actors, or that can constrain systems. As it is the case in many sharing economy platforms (Breidbach and Brodie 2017), P2P lending platform LendingClub orchestrates the formation of actor-interactions including information about credit scores or potential returns, thus signaling prospective lenders whether or not to invest. Hence, it is important to better understand if, how, and to what extent the formation and functioning of self-organizing service ecosystems can initially be guided or orchestrated through technology (Breidbach et al. 2015). Particularly, this research call can contribute to understanding the role of technology within service ecosystems (Storbacka et al. 2016). Overall, this paper can serve as a starting point when investigating how to transform, assemble, and achieve coherence in service driven by technology (Breidbach and Maglio 2015; Lusch and Nambisan 2015).

As future steps, we plan to investigate if, how and to what extent coordination mechanisms guide self-organization in digital service ecosystems, in the context of Fintech. Adopting the analytical lens proposed, the study will use agent-based modelling (ABM) simulations to examine the impact of digital coordination mechanisms on the nature, co-creation activities, and performance of self-organizing service ecosystems. We will use ABM as it can better capture properties of self-organizing systems, when compared to other modelling approaches like system dynamics (Mollona 2008). The development process for the ABM simulations will follow the traditional approach according to Macal and North (2014). The study will contribute towards understanding the role of technology in the self-organization of digital service ecosystems.

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