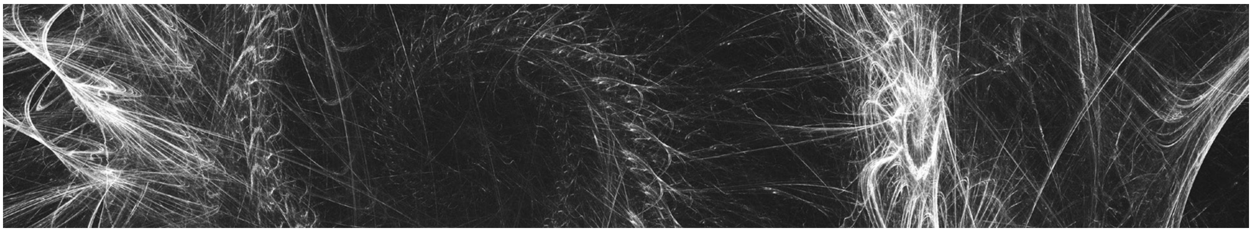
PART IV

Service Ecosystems

Irene Ng



All across the natural and human-made world, we see service ecosystems emerging. Our knowledge disciplines, from sciences to social sciences to the humanities and the arts, are creating endeavours to work together to understand how knowledge is connected and yet distinct. Similarly, humans, technology and the natural environment have also to understand what connects us and what sets us apart. Finally, our man-made world of things, organizations, society and government also need conversations of cohesiveness and distinctiveness. The methodologies to widen our scope of study of service begin with our own willingness to engage in that widening. This section of the *Handbook* focuses on service ecosystems, an important aspect of S-D logic narrative that enables such conversations to happen.

In the first chapter, entitled 'Service Ecosystems: A Timely Worldview for a Connected, Digital and Data-Driven Economy' Irene Ng and Susan Wakenshaw articulate the need for a service ecosystem worldview and explain why its application is pertinent in an increasingly connected, digital and data-driven world. The move towards service systems initially was driven by the need to move beyond a narrow, interactive and causality-driven unit of analysis. Ng and Wakenshaw suggest that not only do we make these studies, these studies make us as well. The development and evolution of S-D logic beyond its original foundational premises (Vargo and Akaka, 2012) sees the introduction of a service ecosystems perspective (Vargo and Lusch, 2011a, 2011b) that can provide a framework for studying wider systems, or the interaction and value co-creation among multiple service systems (Vargo and Lusch, 2011b).

The authors argue that studying a service ecosystems perspective in S-D logic presents an opportunity to do what good researchers endeavour to achieve – interrogate paradigmatic assumptions and critique worldviews for service research. It does this in two ways: by 'zooming out' and *broadening* the perspective, and by allowing the *language* of service ecosystems to empower investigations beyond what is commonly studied in service research. The chapter explains why we study service, why service ecosystems in particular, and the role of institutions in the understanding of service ecosystems.

The chapter then moves on to why the service ecosystem worldview is timely, due to an increasingly connected world where the proliferation of the Internet of Things (IoT) and Cyber-Physical Systems (CPS) are expected to bring about the fourth phase of industrialization: 'Industry 4.0'. The chapter discusses the role of service ecosystems in designing future 'Things' or socio-material assemblies (Bjögvinsson et al., 2012) that focuses on creating new constituents and boundaries where transactions can be created. It also considers how a service ecosystem view can help articulate the challenges faced in the world of a data-driven economy. The chapter illustrates how a service ecosystem view can enable the design of a solution – such as the Hub-of-all-Things (HAT) (https://hubofallthings.com) artefact – to ease the tensions between privacy risk, harm and threat brought about by the exchange of personal data on a secondary market. Finally, the chapter presents how a service ecosystem view can inform the understanding of data as a resource when it is co-created with an ecosystem's actors for personalisation, engagement and recommendations.

The next chapter, entitled 'Systems Behavior and Implications for Service-Dominant Logic', by Philip Godsiff, Roger Maull and Phillip Davies, discusses in much greater detail the systems thinking (ST) approaches and the ongoing development and maturing of S-D logic. ST has been a key influence on the development of S-D logic and has overcome the principal failings of reductionist approaches to social reality. S-D logic has evolved from a service system to the concept of a service ecosystem; the authors stress that 'the term was developed by ecologists seeking to understand how living organisms reacted within their environment in natural systems, as a move away from more limited views'. The chapter discusses the three resources (competences, relationships and information) that typically hold together the social and economic actors of a service ecosystem. Institutions (broadly: rules, assumptions and practices) and their frameworks provide the context in which value can be co-created through the processes of the ecosystem. S-D logic emphasizes that the structures or institutions that guide the actions within a particular system are often composed of multiple viewpoints. This is a key system thinking concept (Sewell, 1992; Giddens, 1984). S-D logic brings in the ST concept of hierarchy and control by including processes and relationships and the emergence of three levels – macro, meso and micro – with interactions between and affecting each level (Akaka and Vargo, 2015; Fisk et al., 2016). Refinement and growth of S-D logic have come from a process of 'zooming out' to give a wider dynamic and 'holistic' perspective (Vargo and Lusch, 2016). This approach is similar to Churchman's 'unfolding and sweeping in', allowing for multiple perspectives. In addition, the embracing of ecosystems and dynamic systems thinking, rather than a static network approach and cross-fertilization with institutional logic, provided theoretical underpinning for the mechanisms. The holistic 'zooming out' approach would enable researchers to move beyond dyadic relationships between producers and consumers through static networks to a more holistic actor-oriented view. The gestalt change stimulated by ST from 'parts to whole' is a significant step for S-D logic. This has opened up new opportunities for S-D logic, with the new 'lens' providing the ability to 'see' the whole, not parts, and 'think' in terms of a dynamic reality with emerging complexity, relationships, processes and patterns. Based on the review, Godsiff et al. suggest the shift in perspective is (1) from parts to the whole; (2) from objects to relationships; (3) from structure to processes; and (4) from measuring to mapping. They also propose that these shifts would lead to new research areas in markets and marketing. This chapter analyses what and how S-D logic has achieved a gestalt change from a systems viewpoint, with the analysis explaining the theoretical underpinning for service ecosystems in S-D logic. The chapter goes on to provide various exploratory avenues that S-D logic research can draw on from ST as researchers continue their development in both S-D logic and systems thinking.

The first two chapters therefore give a detailed understanding of the ecosystem aspect of service. The next chapter, entitled ‘The Study of Service: From Systems to Ecosystems to Ecology’, by Irene Ng, Paul P. Maglio, Jim Spohrer and Susan Wakenshaw, moves on to the evolution in the concept of service, and how it embraced systems, before discussing the concept of ecology. The chapter starts by interrogating the concept of service. This normative position is important to understand the existing and future research in the area. However, the interrogation shows that, despite the increasing importance of service, service was historically defined through a goods-dominant logic lens. The study of service became an inferior class of these purer knowledge bases in the 1980s and 1990s. The publication of the first S-D logic paper in 2014 marked a step change in the understanding of service. Since then, S-D logic has become a unifying framework for service, and has developed into an axiom-based discipline, approaching a ‘near theory status’ (Vargo and Lusch, 2017). This chapter systematically reviews the concept of service systems and discusses how it evolved into the service ecosystem concept. It also describes another parallel endeavour to advance knowledge in service, i.e. service science. Despite being deemed two research communities, they have appropriated terms and language that are similar at the core but often nuanced around the edges, due to the privileges accorded by the two communities. Recently, both communities have embraced the concept of ecology. S-D logic has evolved from the concept of a service system to that of a service ecosystem. The chapter continues from ecosystems to service system ecology, which is defined as the macro-scale interaction of the populations of different types of service system entities. The universe of all service system entities forms the service system ecology, and the authors posit that the most appropriate concept for service science is ‘ecology’ rather than ‘ecosystem’, to stress the evolving ecology of service system entities. This difference is due to the different philosophical approaches taken by S-D logic and service science. S-D logic provides the theoretical underpinning and language to reconcile many different approaches, enabling the sharing, application and, importantly, the advancement of what we know and do not yet know. Service science, on the other hand, takes a more normative position of what is a good, sustainable and robust service systems ecology.

The final chapter in this section is by Javier Reynoso, Sergio Barile, Marialuisa Saviano and Jim Spohrer, and is entitled ‘Service Systems, Networks, and Ecosystems: Connecting the Dots Concisely from a Systems Perspective’. The chapter aims to elaborate on S-D logic. The authors argue that service research has progressed along pathways that can be traced to three building blocks focusing on three levels of analysis: the system level (the actor’s level of local service systems); the network level (the relational level of nested, networked configurations of service systems); and the ecosystem level (the holistic level of the whole ecosystem dynamics). These representations (service system, service networks and service ecosystems) are different kinds of service entities. They represent different view levels of the whole dynamics, which appear when enlarging the focus from the parts (local system) to the relationships (networks) up to the whole (ecosystem) interconnected service system dynamics. The authors suggest that the notion of service ecosystem developed by S-D logic is built upon the analogy with ecology. Based on the three-level representation of service research, they further elaborate on the following questions: how can the three domains/perspectives be connected via systems thinking? By considering this, the authors aim to address the issue regarding a general theory of service. This endeavour is important because both S-D logic and service science aim to provide a normative position for service. It is suggested that the adoption of systems thinking is an interpretive approach capable of 'integrating the required knowledge resources' as fostered in inter-and trans-disciplinary research. It is argued that S-D logic provides a worldview and mindset that is both transdisciplinary and systems thinking in nature, and also rooted in marketing, with five core axioms that concisely connect the dots for understanding the design and evolution of service systems, networks and ecosystems. Another question the chapter addresses is 'do different research problems emerge when enlarging the view from local service systems, to networked service systems, up to service ecosystems as a whole?' The authors argue that there is a need for a general level of principles that can inform behaviour and action at any level of interactions. They suggest that S-D logic can provide the required set of general principles and rules that can normatively direct actors' behaviours in interaction processes from the local to the ecosystem level in order to co-create value. Thus, the adoption of a system approach provides a methodological, well-grounded and reliable basis for connecting the multiple 'dots'. In conclusion, Reynoso et al. suggest that S-D logic research has had the merit of capturing the inner dynamic and systemic nature of service. Subsequently, by embracing the ecosystem view, it has made a further step forward toward the building of a general theory of service.

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12

Service Ecosystems: A Timely Worldview for a Connected, Digital and Data-Driven Economy

Irene Ng and Susan Wakenshaw

INTRODUCTION

S-D logic has progressed, developed and evolved beyond the nascent perspective and framework stage with the revision, elaboration and extension of the original foundational premises (Vargo and Akaka, 2012). This development has led to the introduction of a service ecosystems perspective (Vargo and Lusch 2011a; 2011b). This 'ecosystem' view can provide a framework for studying wider systems, or the interaction and value co-creation among multiple service systems (Vargo and Lusch, 2011b). This section of the *Handbook* sets up the need for a service ecosystem worldview and an explanation of why its application is pertinent and important in an increasingly connected, digital and data-driven world.

SERVICE ECOSYSTEMS

Why Service Ecosystems

Three of the most important aspects of doing research are (1) the choice of unit of analysis, which includes discarding (2) what is outside the unit of analysis as beyond the scope of our study, and (3) the worldview we adopt as researchers when researching that unit of analysis (see Figure 12.1).

Here's an illustration. Imagine we are investigating consumer-browsing behaviour in a supermarket by watching shoppers on the supermarket floor. Through CCTV cameras, interviews and observations, we can study, evaluate and surmise what is going on with shoppers. We might see how shoppers browse, the items they pick up, put down or buy. Our unit of analysis, which is the shop floor, has a few implicit assumptions. First, the phenomenon that we believe is worth studying is the shop floor (the unit of analysis). Second, we are observing and investigating what is visible to us and discarding what we might not be able to see as outside the scope and, third, by studying only the phenomenon on the shop floor, we see a particular 'truth', a particular perspective of the shop floor. This perspective is that of the supermarket, or a consumer

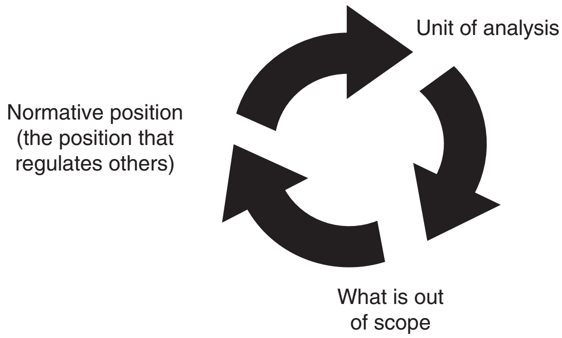

Figure 12.1 Three important aspects of doing research

group, depending on who commissioned us to do the study and why.

The point here is that we often don't hold researchers to account on these aspects; our *a priori* positions. Why study the shop floor that way? On what basis have we discarded that which is not in our scope and what normative position do we hold?

A normative position is what constitutes 'a norm'. It is a position that regulates others. It is the world according to the commissioner of the research; the normative position that results in the choice of the unit of analysis (shop floor) and also what is out of scope (outside the shop floor).

Such is the nature of service research today. Without interrogating our normative positions, we often assume that firms should exist, governments want the best for their people, consumers want lower prices, satisfaction is important, and wellbeing even more so. As researchers, we choose to study firm–customer interactions, the marketing actions of organisations, the transformative value of health providers, or the satisfaction of consumers. We naturally assume a set of norms and therefore when we do our research our choice of what is interesting, what is good research, is prescribed within this normative position. Over time, we reinforce these norms through a formal set of terms and frameworks, developing the language of research in service that is tied to the effectiveness and efficiency of the firm, or the sentiment of the customer or staff, and the nature of the relationships, often dyadic. This language we have created from all our research has become our worldview. It has become performative in the way we see the world – that of firms, customers, governments and environment. They are so structurally entrenched in our worldview that, often, we don't even question them – we naturally ascribe to a position where these terms must exist in all our work in order for it to be meaningful.

Such an entrenched worldview has historical roots. Service research evolved over several decades from its beginnings in the 1970s and the landmark *Journal of Marketing* article on services by Lynn Shostack (1977). Tronvoll et al. (2011: 561) argued that service research has primarily centered on practical issues with managerial relevance, e.g. 'measuring and managing service quality, generating service scripts, blueprinting the service process, designing new services, creating a service culture, developing service recovery strategies'. Over time, service researchers have proposed different priorities in terms of research topics for future service research (e.g. Ostrom et al., 2010; 2015), with an emphasis on their practical relevance. Indeed, Bitner and Brown (2008) used the term 'service imperative' to promote a focus on service research and innovation across companies and institutions globally. They proposed that embracing the service imperative would bring about improved wealth and benefits to companies and, in turn, nations, leading to improved quality of life for people worldwide. As Tronvoll et. al. (2011) put it, there has been little endeavour to discuss ontological or epistemological issues and paradigmatic assumptions that shape service research (Tronvoll et al., 2011).

The Service-Dominant or S-D logic (Vargo and Lusch, 2004; 2008) and service science initiatives (Spohrer et al, 2007; Spohrer and Maglio, 2008; Maglio and Spohrer, 2008) provided foundations for service research to engage in paradigmatic discussions.

Chesbrough and Spohrer (2006) stressed the need for a wider understanding of modern service, suggesting that the fundamentals for understanding the service sector that has dominated economic activity in most advanced industrial economies are lacking (Chesbrough and Spohrer, 2006). The publication of the seminal papers 'Evolving to a new dominant logic for marketing' by Vargo and Lusch (2004) and 'Steps toward a science of service systems' by Spohrer et al. (2007) saw the emergence of a new worldview that has gained momentum in shaping business and economic thinking for the twenty-first century; one that is not merely driven by firms or customers but through an understanding of the service system (Maglio et al., 2009). S-D logic suggested that the generalisable worldview is based on service, even when goods are involved. In understanding why and how entities behave to create value, the unit of analysis is the service system.

S-D logic as a perspective for service has been extensively discussed (Vargo and Lusch, 2004; 2008; Vargo and Akaka, 2009; Vargo and Lusch, 2016), while its fundamental premises have been explained/justified (Vargo and Lusch, 2004; 2008; 2016; Vargo and Akaka, 2009). For example, S-D logic's basic tenet is that service – the application of competences for the benefits of another – is the basis of all exchange (F1). In other words, service is always exchanged for service; thus all economies are service economies (FP5). Customers are always co-creators of value (FP6); all economic and social actors are resource integrators (FP9). In S-D logic, value is co-created by the service provider and the service beneficiary (e.g. customer) through service provision and exchange via resource integration (Vargo and Lusch, 2004; 2008; 2016). Value co-creation always involves a unique combination of resources and an idiosyncratic determination of value (see FP10) (Vargo and Lusch, 2008). S-D logic advocates shifting the focus from operand to operant resources, signifying that the emphasis is placed on competences of enterprise and skills and knowledge of employees, and other value creation partners such as customers (Vargo and Lusch, 2008: 31). This shift highlights the notion that people exchange to acquire the benefits of *applied specialised operant resources* and, as such, exchange service for service. In S-D logic, the 'customer' is an actor with operant resources – a resource that is capable of acting on other resources – and is therefore a collaboration partner who co-creates value with the firm (Lusch, 2007). Customers as value creation partners are actively involved in value co-creation via the application of their operant resources. It is argued that service-for-service exchange was recognised as a theoretical foundation for the development of service science and the study of service systems (Maglio and Spohrer, 2008; Vargo and Akaka, 2012: 207).

The study of a service ecosystems perspective in S-D logic is an opportunity to consider worldviews in service research. It presents an opportunity to do what good researchers endeavour to achieve – interrogate paradigmatic assumptions and critique worldviews for service research. It does this in two ways.

First, by 'zooming out' and *broadening the perspective*, which is implied in S-D logic FP9 and in the wording of FP6 that was updated in Vargo and Lusch (2016). In S-D logic, value creation occurs among multiple service systems (Vargo and Lusch, 2010; Vargo and Akaka, 2012), implying that resource-integrating behaviours must also be contributed by other actors. As a consequence, S-D logic took on a systems orientation, and with it, the necessity to explore different methodologies that systems thinking has to offer. Second, the licence to step out of a worldview is given through *the language of service ecosystems,* allowing the language to empower investigations beyond what is commonly studied in service research. This chapter will elaborate on both the broadening and the language used by service ecosystems as well as introduce the three service ecosystem chapters in this *Handbook*.

A Systems View

S-D logic's move into a systems view is no coincidence. It is motivated by the need for sense-making in a modern-day era where social media interaction can produce fake news, and over-usage of antibiotics can create superbugs. It calls into question the underlying assumptions of the world we knew before – that investigating a narrow unit of analysis for potential cause and effect misses the opportunity to understand what is truly happening if one took a broader perspective instead. Also, assuming that the narrow view of the phenomenon can be suitably explained only by what is happening within that view contributes very little to our understanding of our world.

A service ecosystems view also has a distinctive impact on the conduct of research. Going back to the shop floor, a service ecosystem unit of analysis is essentially reducing the bigger system (e.g. spending) to a smaller system (spending at a supermarket). Since all the world is an ecosystem, a service ecosystem unit of analysis requires the researcher to justify his system-in-focus, both in terms of its reducibility that considers the wider system 'out-of-scope', as well as the boundaries of the chosen ecosystem, and why. In other words, every chosen service ecosystem is a part of a whole, and while it is perfectly legitimate to investigate only a part, its membership within the whole makes explicit the assumptions that would normally not have been clarified.

S-D logic has been recognised as an important framework for the study of service systems (Maglio and Spohrer 2008; Vargo and Lusch, 2010). First, an S-D logic approach to service systems encompasses processes, rather than the output, of value creation; service systems as the outcome of resource integration and value co-creation (Vargo and Akaka, 2012). S-D logic has further evolved to a service ecosystem perspective. The S-D logic, service-(eco)system view aligns well with various theories on systems (e.g. see Barile and Polese, 2010; Ng et al., 2011) and provides a conceptual foundation for the consideration of service system as a 'network of agents and interactions that integrate resources for value co-creation' (Ng et al., 2012: 231). This is because, as with other systems thinking, S-D logic and its ecosystem view considers service ecosystems to be emergent, dynamic networks of actors and their interactions. A service ecosystem view also strongly emphasises institutions, or social norms (Williamson, 2000), as a central driver of the actions and interactions that enable value co-creation as well as service systems (re)formation (Vargo and Lusch 2011a; 2011b; Vargo and Akaka, 2012: 208). Thus, we argue that a service ecosystem perspective would provide the new worldview and unit of analysis for service research in the twenty-first century.

The Language of Service Ecosystems

While systems theory has been around for a while, its incorporation into service ecosystems work in S-D logic provides a language and a framework to view and study the service phenomenon in a different way, and perhaps draw different conclusions.

The service ecosystem view in S-D logic is defined as a 'relatively self-contained, self-adjusting system of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange' (Vargo and Lusch, 2011b; Vargo and Akaka, 2012: 207; Vargo & Lusch, 2016: 15). Its definition is necessarily uncommon, to put forward a different language, one that is more abstract, so that conversations in service research can be reframed. The language of service ecosystems is an epistemic object of sorts that scaffolds knowledge of one worldview to another. From the use of the word *actors*, instead of firms or customers, S-D logic conceptualises actors as all entities, whether firms or people, that fundamentally perform the same behaviour; that of integrating resources and co-creating value through service exchange (Vargo and Lusch, 2016). From the focus on *service* in the early years of S-D logic and now to *service ecosystems*, S-D logic evolved its language to permit a broader view of a phenomenon; that it is not beyond the remit of service and marketing and, indeed, business researchers as a whole, to have a stake in the wider perspective. Even in a rather straightforward process of selling, often viewed narrowly as a firm's activity in organising transactions with customers, there are emergent outcomes such as markets and industries at the meso and macro levels that result in a circular relationship where these outcomes generate an impact back onto the selling interaction. This in turn results in outcomes becoming contexts (cf. Giddens, 1986) for the selling phenomenon being investigated as illustrated in Wieland et al. (2017). The language of service ecosystems, its abstractions and concepts contributes to the ability to understand our reality without artificial boundaries imposed by our existing knowledge and disciplines.

Why Service and Why Ecosystem

Service ecosystem in S-D logic isn't merely systems theory; it specifically sets out why and when a system is a *service* ecosystem, which is when the flow between actors is that which results in mutual value creation, through actors' service-for-service exchanges. This concept is often misunderstood in research. Often, researchers assume some normative and transcendental 'value' placed on a system, and that the resource-integrating behaviours of actors go about to 'achieve' that value. This often happens when a researcher studies a particular system, e.g. a hospital, and assumes a worldview of it, observing the actors within to decide what behaviours might contribute (or not) to the 'value' of the system (e.g. a 'well-run' hospital). While this can still be accommodated within service ecosystem research if assumptions are made explicit, the positive service ecosystem approach would look at factual reasons why the actors are members of the system, participating in service-for-service exchanges, for example work-for-salary, and how their resource-integrating behaviours are coordinated and constrained by the actors' institutions and institutional arrangements (Vargo & Lusch, 2016), in this case union rules, performance targets and the organisation's rulebook, and would evaluate the system much more positively than normatively.

The use of the term *ecosystems* is also important, as it emphasises the mutual value creation and continuing mutual service provision that reinforces the viability of a system, keeping actors within it rather than exiting it. A network of resource-integrating behaviours is expected to be dynamically evolving and changing and by the fact that no actor is motivated to exit the system being observed, the system must continue to remain viable for all actors within it. Thus, the term 'ecosystem' illustrates the self-adjustment, reinforcement and adaptability of the actors within it, ensuring the system's viability through such exchanges and often creating network effects (Vargo and Lusch, 2016).

Coordination and Mechanisms

An essential aspect of service ecosystems is the way actors coordinate, and the mechanisms through which they are able to co-create value and enact resource-integrating behaviours. To this end, Vargo and Lusch (2011a) discuss extensively the role of institutions and institutional arrangements. Institutions – human-made rules, norms, beliefs – constrain and enable action. They are the structures that guide our 'living performances'; the act of being and acting with meaning (Scott, 2001). By institutionalising an action, such as brushing our teeth or driving a car, the human being expends less cognition. Every service ecosystem of actors not only includes value co-creating resource-integrating activities, but also performs institutional work – maintaining these rules and norms, sometimes disrupting and adapting institutional structures (Lawrence and Suddaby, 2006). Institutions and institutional arrangements give us confidence that the car on the opposite side of the road will not suddenly, without reason, swerve into our lane. Service ecosystems of mutual value creation depend on institutions and institutional arrangements for order and function. The more actors share an institution, the more mechanisms can be developed to benefit everyone and the better the coordination is within the system.

APPLYING A SERVICE ECOSYSTEM WORLDVIEW TO THE CONNECTED, DIGITAL AND DATA-DRIVEN WORLD

A Service Ecosystem View in an Increasingly Connected World

The need for a service ecosystem view is accentuated by an increasingly connected world. We are in an era of the Internet of Things (IoT), where its proliferation along with that of Cyber-Physical Systems (CPS) is expected to revolutionise manufacturing and bring about the fourth phase of industrialisation: 'Industry 4.0'. Under Industry 4.0, intelligent manufacturing would shift centralised production towards decentralisation, while standard products will become personalised with increased user participation in design (Zhou et al., 2015). Hence, a service ecosystem worldview would play an important role in obtaining a better understanding of decentralised production and the delivery of personalised products to serve the needs in contexts and in real time. Indeed, Ng and Wakenshaw (2017) used S-D logic to conceptualise IoT in four ways. First, as the setting for liquification and density of information sources crucial for achieving resource density in context. Second, as digital materiality, enabling the harvesting of real-time information of objects, interactions and the environment. Third, viewing IoT as a 'whole', constructed by its constituents and emerging from the ongoing interactions among its heterogeneous constituents. Fourth, considering IoT as modules, transactions and service, allowing the rearrangement and re-combination of resources for a particular situation. Combining these four conceptualisations implies the creation of a set of IoT capabilities at an Internet-connected constituent's level as well as at the system level. Whether it's Industry 4.0 or Consumer Internet-of-Things, the service ecosystem worldview and language espoused by S-D logic would enable a better description and understanding of such technologically advanced environments and how they would impact on firm profits, human experiences and personalisation in social–cyber–physical systems. As Matzner et al. (2018) put it:

> The language of service ecosystems in S-D logic supports this process perfectly because there are no predefined notions of existing bundles of resources inscribed in its vocabulary. It does not need to include any reference to specific devices, roles and institutions of current industry. As an 'actor' in a system, it is a bundle of competencies of which become resources in context for value creation and it can have a form, and then change its form dynamically to suit a context. This makes the understanding of an 'actor', competency and resource appear very abstract and hard to grasp on one hand, but on the other, ideal to support a

> revolution of the views on objects (particular digital/software objects) and even for the business in the course of the digital transformation. (Matzner et al., 2018)

Technology is also often discussed in service science. However, the S-D logic discourse that takes a more abstracted worldview considers technology much more generally as an institutional artefact (Vargo et al., 2015), an applied, useful knowledge (Mokyr, 2002) where knowledge is itself a part of an institutionalised structure we collectively construct as a society. It might seem that such abstractions and language are unnecessarily verbose but, paradoxically, the biggest contribution of service ecosystems to research is exactly the use of more abstract and rather uncommon words to strip back some of the value-laden lexicon in existing service research in order to more fully investigate a phenomenon. This then enables researchers to practically understand and design artefacts in the modern era, whether they are markets, physical products, social systems or the data-driven, digital economy.

The Need for a Service Ecosystem View in Designing Future 'Things'

A product is a bundle of benefits, whether physical or otherwise, formed by our institutionalised minds on how it serves to meet our needs. It enables and disables (Giddens, 1986). It enables us to use it to meet our needs, but it also disables in the sense that it meets our needs in a rigid way. For instance, the landline telephone met our need to communicate, but in a very rigid manner, because we have to be at home in order to use it. Similarly, a car meets our need for mobility and transport, but in a rigid way. We can only use it in places where there are roads, and where our driver's licence is valid. There are many rules to comply with when we use a car, from traffic regulations to car safety guidelines. So, a car enables us to get from point A to point B, but it also disables us in terms of how these rules and regulations, the rigidity of the structures around car usage, impose all kinds of restrictions on our freedom. To look into the future where we wish to live in a better society, we need to look no further than how we design things and systems, because the connectivity between things and people will drive the resources that we put into context for creating value, and these resources in contexts will be the templates of our future behaviours. The more rigid any offering or service system is in meeting our needs, the more rigid our behaviours are around this product and, in turn, the fewer degrees of freedom we have. While a certain level of rigidity and structure is very useful to enable society to function and standardisation provides manufacturers with economies of scale, it does come at a price; it curtails human freedom in terms of what individuals can or cannot do.

Service ecosystems have a big role in designing future 'Things'. A service ecosystem approach for design isn't about a design for function, but for interactions, functions, choice, freedom, structures and roles. By being positive in its approach, it allows for various normative positions to be taken in design. In contemporary design discourse and rhetoric, Björgvinsson et al. (2012: 102) argued that the challenge to designers and the design community is to 'move from designing "*things*" (material objects) to designing *Things* (socio-material assemblies)'[1]. Two approaches to *design Things* emerge. In addition to the traditional approach ('use-before-actual use') focusing on 'anticipating or envisioning use before actual use' in people's life world, another complementary approach ('use-as-design or design-after-design') emphasised the ongoing and 'anticipation or envisioning of potential design that takes place in use after design of a specific project'[2] involving future actors (2012: 104). Therefore, there is no division between 'use-before-actual use' and 'use-as-design'. This division represents the one between G-D logic and S-D logic, and the latter would contribute to design thinking by resolving the division. When value is co-created among actors to meet users' needs through resource integration, and service exchange is connected via institutional arrangements, offerings are designed to directly or indirectly provide the relevant resources for resource integration and for high density of resources among actors in the service ecosystem in dynamic contexts. These resources are provided in view of their actual use for the benefit of the beneficiaries. Resources are not static and atomistic nouns; they only 'become' in context through enabling 'verbs', whether sitting, reading, talking or eating. Before the context, nouns are merely value propositions or properties (akin to 'potential energy' in physics). Thus, the relevance of resources and resource provision and integration are emergent from the interactions of actors in the context of an emergent ecosystem (the 'kinetic'). In this sense, resource integration and service exchange involve all the future users/stakeholders in value co-creation. Indeed, Lusch and Nambisan (2015) proposed a service innovation framework by employing a service ecosystem worldview in S-D logic that includes three components: (1) service ecosystem as an emergent actor2actor network entailing organisation of loosely-coupled actors through a shared worldview, architecture for participation and structural flexibility and integrity to sustain the ecosystem; (2) service platform for enhancing level of resource density through layered-modular architecture and rules of exchange; and (3) value co-creation as a resource integration process entailing diverse actor roles and a requirement for a supportive environment (Lusch and Nambisan, 2015).

It is argued that *designing Things* needs to align all resources, whether human or non-human, as well as understanding agency and the 'verbs' within the context (Bjögvinsson et al., 2012). This is particularly relevant when it comes to the product scape of IoT. Baldwin (2007) considered consumer consumption practices as taking place in a task network involving 'nodes' ('task-cum-agents') and 'links' ('transfer of material, energy and information' between 'tasks' and 'agents'). These agents could be human, objects and/or digital agents who possess skills, information and material. More importantly, transactions occur within this task network, involving interactions and transfer of skills, information and material between agents. One function of transaction is to divide one set of tasks with others (Baldwin, 2007: 156). Ng and Wakenshaw (2017) conceptualised IoT constituents as architectural modules, with capabilities that could converge and diverge to create 'thin crossing points'[3], i.e. a boundary and a transaction between the modules' tasks for actors, by dividing skills and competences between actors. This paves the way for designing the networked products of IoT as 'socio-material assemblies' (Bjögvinsson et al., 2012; Ng and Wakenshaw, 2017). Through modularising consumption practices as tasks for the design of thin crossing points, new resources (e.g Internet-connected constituents) can be brought in and new transactions can occur (Ng and Wakenshaw, 2013). Thus, the design of IoT's network product focuses on designing new constituents and boundaries where transactions can be created.

The Need for a Service Ecosystem View in the Data Economy

The increasingly connected digital economy is also spewing out petabytes of data. The notion of data in a connected economy is almost analogous to the service ecosystem view of resources; data has no value on its own but is merely value propositions, with tremendous value when applied in context. However, data only exists because it has been collected by an 'actor' such as an organisation. Hence, the structure of the data, the way it is presented and organised, has been institutionalised for the collector's benefit. When it is liberated due to connectivity and data brokerage, much of such data becomes fragmented as a combination of multiple institutional arrangements of data from multiple sources. Such 'big data', as it is called, is often described as a 'large amount of data which requires new technologies and architectures so that it becomes possible to extract value from it through the capture and analysis process' (Katal et al., 2013: 404). The notion of big data has shifted from '*big*' (volume, variety and/or variety); (TechAmerica Foundation's Federal Big Data Commission, 2012; Gandomi and Haider, 2015; De Mauro et al., 2016) to '*smart*' (insights) (George et al., 2014) and to '*value*' for individuals, businesses, communities and governments (McKinsey Global Institute, 2011; George et al., 2014: 321). It is suggested that the concept of big data entails three aspects: (1) technology problems, i.e. collecting, storing and analysing the large volume of data; (2) commercial value, i.e. insights from data; and (3) societal impacts of big data, i.e. privacy, regulations for commercial use of this data (Nunan and Di Domenico, 2013).

A subset of big data[4] is 'personal data' (George et al., 2014), now accounting for 36% of data brokering activities globally (Transparency Market Research, 2017). The Data Protection Act 1988 defines personal data as storable or processable information which relates to a living individual and by which an individual can be identified. This definition of personal data as relating to an identified or identifiable person or persons is widespread across literature (e.g. Schwartz, 2004; Gross and Acquisti, 2005; Schwartz and Solove, 2011; World Economic Forum, 2013).

In the personal data space, there is a lack of definition on what makes data personally identifiable information. For example, Schwartz and Solove (2011) argued that information that appears on the face of it to be non-identifiable can be turned into identifiable data through IP addresses, re-identification, changing technologies and data-sharing practices. If you only have location data without any identifiable information, the fact that a person is not moving between 11pm and 7am would certainly suggest that the person is at home, and combining publicly available data on employees of organisations and the electorate roll would easily result in the person's identification. The ability to identify is becoming increasingly contextual – changes in personal preferences, new applications, context of uses, and changes in cultural and social norms can be inferred and dynamically updated. As such, the definition of personal data as identifiable or non-identifiable is constantly evolving (World Economic Forum, 2013).

Personal data is an asset for firms and individuals, and it fuels much of the Internet. For firms, access to, and use of, personal data can improve their decision making (Brynjolfsson et al., 2011; Brown et al., 2012) and enable them to deliver a holistic product experience (Fleischmann et al., 1997; Jun et al., 2007; Guédria et al., 2015; El Kadiri et al., 2016) and provide real-time and personalised services (Brown et al., 2012). For individuals, personal data is an asset, as giving consent for accessing and using their personal data enables them to get immediate monetary compensation (e.g. discounts), information-based price discrimination and intangible benefits such as personalisation and customisation of information content, and to be better informed by receiving targeted ads (Acquisti, 2010). However, firm's data practices (collecting, storing, analysing and exchanging personal data) at the scale that currently exists on the Internet has reached a level where negative externalities are being manifested. Firms run the risk of being penalised by the market for being perceived as invasive of consumers' privacy by collecting consumer data but not adequately protecting it (Ponemon, 2009). Costs are increasing due to regulatory compliance and the need to protect and secure data (Acquisti, 2010). Other negative externalities also include (1) the invasion of privacy, both subjective and objective (Calo, 2011); (2) privacy costs such as psychological discomfort, i.e. the embarrassment or social stigma and the effect of fear, a state of uncertainty associated with privacy costs; and (3) higher prices paid due to (adverse) price discrimination with consumers being manipulated towards services they do not need because of segmentation and profiling by firms (Acquisti, 2010).

A service ecosystem worldview for data is timely. The understanding of what data is from an S-D logic perspective brings it back to first principles. Data is an institutional artefact (Vargo et. al., 2015). It is a symbol and a visual cue, making sense only because of our beliefs, i.e. our institutionalised logic. We can conceive the 'first' data to be a scratch on a cave wall, a marking to denote the height of a child. If one did not know it was there for this purpose, it would be just a scratch on the wall. However, by the nature of the way the scratch is organised, we believe it could be a height marking. Hence, we rely on the institutions we have crafted for sense-making. Similarly, the markings in the picture (see Figure 12.2) would lead one to believe that they are 'data' made by prisoners counting down the days to their release.

When data becomes digital, it is encoded as a *bitstring* – a sequence of binary digits, 0s and 1s (Quah, 2003). Such a bitstring affects the payoff to some actor in the economy, which is why it was created in the first place, and in doing so, it becomes a digital good and a resource. There is a common

Figure 12.2 Non-digital data

(mis)understanding that data is structurally constituted within a hierarchy, i.e. data becomes information and then knowledge and finally wisdom; the DIKW pyramid (Rowley, 2007). However, Tuomi (1999) argued for a more complete picture. As he put it:

> Someone has articulated knowledge using languages and conceptual systems available, and – in the case of a computer database – represented the articulated knowledge using a predefined conceptual schema. Someone else then accesses these data and tries to recover their potential meaning… Thus, the data-information-knowledge hierarchy emerges only after the knowledge-information-data articulation has created data.

Put simply, the cave mother, in her wisdom and the need to craft an understanding of her child's growth (knowledge), stores that information by marking the wall, thereby creating data. Years later, archaeologists find the markings (data) and attempt to reconstruct the information to infer the knowledge and wisdom of cave dwellers, often with other pieces of data.

This perspective is an important understanding of what makes data 'personal' and when and how data creates value within service ecosystems. More importantly, it gives insight into the negative externalities associated with personal data. Since almost all of personal data is organisation-controlled, a term we refer to as organisation-controlled personal data (OPD), the databases were articulated by organisations' knowledge systems, and institutionalised in such a way that makes sense within these organisations. When personal data becomes liberated through connectivity or re-selling, a secondary market emerges due to its potential benefit as a resource. However, its use is ambiguous and uncertain. Yet it is of great value to advertisers and manufacturers, since it can be used to influence consumer spending across all economies, albeit at some societal cost in terms of privacy loss (Acquisti et al., 2016). Leading companies operating in the global data broker market include Axiom, Experian, and Equifax, and personal data accounts for a 36% revenue share of this market (Transparency Market Research, 2017). In these markets, data brokers aggregate and analyse consumers' data to make inferences about them, including sensitive ones. From a service ecosystem perspective, it is clear that re-identifying individuals through the connection of disparate OPD provides maximum resource density to co-create value in data-driven economies. Anonymisation and aggregation may destroy the original institutionalised logic and structure of OPDs, necessary to comply with some regulatory authorities such as in Europe, yet a market emerges to reconstitute it to achieve density because the resource is much more valuable when the structure of the data is aligned to a person. Indeed, as a Federal Trade Commission study[5] has revealed, the scale and scope of personal data collected and held by brokers are staggering. For example, one data broker's database has information on 1.4 billion consumer transactions and over 700 billion aggregated data elements. The report also indicates that data brokers collect personal data from many resources largely without consumers' knowledge. To attempt to regulate a market of that size for a resource so valuable would either force the market underground or result in regulatory arbitrage, where firms would choose to move to jurisdictions with lower regulatory controls. Since data and digital firms work across borders on the Internet, this would only result in tax losses for advanced economies and higher costs for the compliant. The personal data economy is clearly showing tensions between the privacy risk, harm and threat brought about by data exchange on the secondary personal data market and the value of the resource when co-created with actors in the ecosystem that desire it for personalisation, engagement and recommendations.

A service ecosystem view in articulating the challenge above may also provide a designed solution. The Hub-of-all-Things (HAT)[6] artefact proposes a novel approach. If resource density is highest with identification and co-creation occurs between actors, in this case the organisation and the person, the organisation is not the only actor in the service ecosystem that can create density. Individuals themselves could be the resource integrator and provider of the value proposition – personal data. The approach taken is to create a new technological artefact – a HAT personal micro-server that could be owned by persons, resulting in their ownership of all rights over the data within it. By designing an artefact that is accessible only by the person, and with the person controlling and processing the data within, a clear boundary of person-controlled data rights can be achieved. The HAT would enable 'data subjects'[7] to claim their personal data from corporations, store and assemble their data for exchange and trade for themselves, becoming the proactive resource integrator to *supply* organisations with data pertaining to themselves, co-creating value and disrupting the secondary personal data market with a primary data market from its source.

Thus, the change of the location and control of personal data from being organisation-controlled to personal-controlled constitutes a fundamental and disruptive institutional rearrangement in the service ecosystem of personal data, enabling a higher value of resource 'becoming' in context than the current supply of personal data from secondary sources.

It has also been claimed that the whole S-D logic narrative is fractal. Lusch et al. (2016: 2962, emphasis in original) suggested that 'the whole service-ecosystem narrative, including its components, can be understood as *fractal* and, consequently, potentially simple to model, while, at the same time, potentially infinitely complex'. Fractals are often referred to as 'expanding symmetry', where the replication of a system at higher levels exhibits the same pattern as that in the lower levels. By understanding nested service ecosystems as fractals, researchers could hypothesise when, why and how stability or instability may occur, or when systems become unviable. This is closely related to the concept of emergence in systems, covered more extensively in the next chapter. Emergence refers to the property of the whole that arises from the interaction of parts at a lower level. While it is difficult to point to causality, designing interactions that are reinforcing can create influence upwards or downwards between different system levels. For example, understanding fractals and emergence in service ecosystems could help comprehension of how the HAT could disrupt the data market. With OPD being regulated at the highest level by governments for privacy and data protection to alleviate societal concerns, this results in lower quality personal data (due to anonymisation and aggregation) and therefore lower density of resource at the meso level for firms to acquire from data brokers; finally, down to inferior personalisation and recommendations by firms to their customers. With person-controlled personal data (PPD), better quality of personal data is available real time and can be supplied on demand to organisations by their own customers through their HAT micro-servers, a private data account[8], which can then be used for better personalisation and engagement that could in turn switch data brokers over to PPD as the supply of personal data instead of OPD at the meso level. This could ultimately create a positive externality at the societal level; one of greater empowerment and control for individuals.

CONCLUSION

Much of today's world of hyperconnectivity places emphasis on the understanding and design of systems that connect people and things embedded in people's lives, in themselves nested within societal living and the ecology of our planet. Service ecosystems allow the clarification of interactions not merely between actors, but within a system and between systems. The work integrates heavily with systems approaches (covered in the next chapter) and is by no means complete. The community of researchers and practitioners in this space are growing, an acknowledgement of the need for such an approach.

With much of mankind scripted around technology and its usage, a service ecosystem worldview is timely. It can help researchers, practitioners and designers work to understand the paradigm we live under, interrogating the implicit assumptions made, using the language to consider the different ways of designing and disrupting, and building more innovative systems and offerings with greater choice and more degrees of freedom that are sustainable for the planet.

Notes

1 Things – these kinds of socio-material assemblies that Bruno Latour so strikingly has characterized as collectives of humans and nonhumans. […] Things that are modifying the space of interactions and performance and that may be explored as socio-material frames for controversies, opening up new ways of thinking and behaving, being ready for unexpected use (Bjögvinsson et al., 2012: 102).
2 Project is the socio-material Thing… (Bjögvinsson et al., 2012: 104).
3 Thin crossing point: is a point for a transaction, which is likely to be discovered at the boundaries of modules rather than with them (Baldwin, 2007).
4 'Big Data is also a wrapper for different types of granular data. Below we list five key sources of high volume data: Public Data, Private Data, Data Exhaust, Community Data, and Self-Quantification Data' (George et al., 2014: 322).
5 Edith Ramirez, Julie Brill, Maureen K. Ohlhausen, Joshua Wright, Terrell McSweeny (2014). Data Brokers: A call for transparency and accountability, Federal Trade Commission report.
6 https://hubofallthings.com
7 Data subject: an identified or identifiable nature person […] an identifiable person is one who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his physical, physiological, mental, economic, cultural or social identity' (SecureDataService (2018) Article 4,

EU GDPR Definitions. EU general data protection regulation 2016/679 http://www.privacy-regulation.eu/en/article-4-definitions-GDPR.htm accessed 29 May 2018)

8 http://www.wired.co.uk/article/gdpr-personal-data-private-data-accounts

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