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The nature and fundamental elements of digital service innovation

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Abstract

Purpose – This paper addresses the growing fragmentation between traditional and digital service innovation (DSI) research and offers a unifying metatheoretical framework.

Design/methodology/approach – Grounded in service-dominant (S-D) logic's service ecosystems perspective, this study builds on an institutional and systemic, rather than product-centric and linear, conceptualization of value creation to offer a unifying framework for (digital) service innovation that applies to both physical and digital service provisions.

Findings – This paper questions the commonly perpetuated idea that DSI fundamentally changes the nature of innovation. Instead, it highlights resource liquification—the decoupling of information from the technologies that store, transmit, or process this information—as a distinguishing characteristic of DSI. Liquification, however, does not affect the relational and institutional nature of service innovation, which is always characterized by (1) the emergence of novel outcomes, (2) distributed governance and (3) symbiotic design. Instead, liquification makes these three characteristics more salient.

Originality/value – In presenting a cohesive service innovation framework, this study underscores that all innovation processes are rooted in combinatorial evolution. Here, service-providing actors (re)combine technologies (or more generally, institutions) to adapt their value cocreation practices. This research demonstrates that such (re)combinations exhibit emergence, distributed governance and symbiotic design. While these characteristics may initially seem novel and unique to DSI, it reveals that their fundamental mechanisms are not limited to digital service ecosystems. They are, in fact, integral to service innovation across virtual, physical and blended contexts. The study highlights the importance of exercising caution in assuming that the emergence of novel technologies, including digital technologies, necessitates a concurrent rethinking of the fundamental processes of service innovation.

Keywords Digital service innovation, Service ecosystems, Emergence, Distributed governance, Symbiotic design

Paper type Conceptual paper

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1. Introduction

Digital infrastructure has penetrated our lives with unprecedented speed. "More than just bits and bytes, this digital infrastructure consists of the institutions, practices, and protocols that together organize and deliver the increasing power of digital technology to business and society" (Hagel *et al.*, 2010). Since the late 1950s, digitalization has given rise to many highly disruptive technologies, such as the personal computer, the internet, Web 2.0, e-commerce, smartphones, multi-sided platforms (Acs *et al.*, 2021), and, more recently, artificial intelligence (AI), the Internet of Things (IoT) and blockchain (Fehrer *et al.*, 2018). Furthermore, metaverses can transform how we conduct business, interact with brands and others and develop shared experiences as the distinct lines between the physical and digital are increasingly blending (Dwivedi *et al.*, 2022; Hennig-Thurau *et al.*, 2023). According to estimates by McKinsey and Company (2021), the digital economy will account for 25% of the total economy by 2030, and digitalization will continue to unleash novel opportunities and critical challenges for firms and entrepreneurs.

However, as the call for this special issue points out, literature on digital service innovation (DSI) is "fragmented and dispersed across multiple research avenues," and a "unified understanding of what DSI is" is lacking. Arguably, this fragmented understanding is exacerbated by the fact that DSI and its closely related cousin—service innovation—are commonly guided by a production logic, whether implicitly or explicitly (Carlborg *et al.*, 2014; Witell *et al.*, 2016; Helkkula *et al.*, 2018). While DSI has been recognized as a significant strategic lever for enhancing manufacturing processes and gaining a competitive advantage in manufacturing industries (Opazo-Basáez *et al.*, 2021), it has been "largely overlooked by the mainstream service innovation literature" (Raddats *et al.*, 2022, p. 1).

To take stock of DSI, we explore how service innovation and DSI have been conceptualized across diverse streams of literature and how these conceptualizations have shifted over time. This review reveals two deeply embedded but, arguably, problematic assumptions. First, many service innovation studies, including recent DSI research (Soto Setzke *et al.*, 2023; Tao *et al.*, 2018), acknowledge that a service innovation lens appears "appropriate given that digital technologies are often a driver of service innovation" (Raddats *et al.*, 2022, p. 1), yet maintain a production-focused innovation logic (Toivonen and Tuominen, 2009; Witell *et al.*, 2016). This logic emphasizes the dominant role of technology and views technological-driven product improvements as the outcome of service innovation processes (Barras, 1986, 1990; Utterback and Abernathy, 1975).

Second, much of this work adopts the view that a focal actor (e.g. a firm, entrepreneur, or consortium of firms) can singlehandedly orchestrate service innovation processes (Ko and Lu, 2010; Utterback and Abernathy, 1975; Agarwal and Selen, 2009). These assumptions are problematic because, as empirical descriptions of digital and decentralized platforms, big data and metaverses showcase, DSI is a strong exemplar for systemic and cocreative resource integration processes which are impossible to orchestrate by one single actor alone. To remedy this contradiction, this paper *clarifies the nature of DSI from a service perspective*.

We build on service-dominant (S-D) logic (Vargo and Lusch, 2004a, 2016) and recent approaches that view service innovation as experiential (Helkkula *et al.*, 2018) and ecosystemic (Lusch and Nambisan, 2015; Barrett *et al.*, 2015; Chandler *et al.*, 2019). An S-D logic-informed approach highlights that service— "the process of doing something for the benefit of another party"—is not only common to all value cocreation processes but also to all innovation processes (Vargo, 2007). S-D logic's service orientation not only transcends divides between service and product innovation but also between traditional (physical) and digital service innovation. Furthermore, S-D logic's service orientation emphasizes that innovation processes are always embedded in social structures and occur within nested sociotechnical systems in which resource-integrating actors are connected by and shape, institutional arrangements and mutual value creation (Vargo *et al.*, 2015).

As we explore the application of S-D logic to DSI, we reveal its potential as a coherent and unifying metatheoretical foundation. That is, we suggest that S-D logic can offer a comprehensive framework that goes beyond the narrow focus on technology, new services, products, or marketization (Coombs and Miles, 2000), which have been the primary concerns of existing DSI approaches. Instead, S-D logic illuminates the institutional nature of technologies, market dynamics and human experiences in shaping innovative practices. By bridging diverse midrange theories focused on innovation processes, it provides a more holistic understanding that helps to dismantle academic silos and theory fragmentation (Moorman *et al.*, 2019). We argue that this metatheoretical perspective encourages scholars to explore how their work intertwines and interacts with other bodies of research, fostering a more comprehensive and interconnected understanding of DSI and its broader implications (Vargo *et al.*, 2023b).

As its main contribution, this paper explains that increased digitalization impacts three fundamental elements of service innovation. First, digitalization accelerates the *emergence of novel outcomes* because altering intangible algorithms, bits and bytes is often easier and faster than altering tangible objects. Second, digitalization reduces the challenges of coordinating innovation processes because algorithmic and increasingly *distributed governance* permits low-cost exchange among large numbers of actors. Third, digitalization greatly facilitates *symbiotic design,* emphasizing that multiple actors collectively shape the service ecosystems they are part of.

While, on the surface, these three characteristics appear novel and distinctive to DSI, we argue that their fundamental mechanisms are not exclusive to digital service ecosystems but are inherent to service innovation across virtual, physical and blended settings. This points to the need for caution in assuming that the emergence of novel technologies, including digital technologies, necessitates a concurrent rethinking of the fundamental processes of service innovation. To deepen our understanding of DSI, we emphasize the augmented capacity of actors to exchange service in "liquefied" or "dematerialized" forms (Normann, 2001), reaffirming the centrality of service as the fundamental unit of exchange.

2. Foundations of service innovation

2.1 The evolving concept of service innovation

Spurred by accelerating technological advances and a perceived shift toward service economies, the study of service innovation has gained significant attention over the last three decades (Gustafsson *et al.*, 2020; Moreira *et al.*, 2020). Service innovation is now often seen as the main engine that fuels differentiation and growth (Carlborg *et al.*, 2014; Witell *et al.*, 2016; Helkkula *et al.*, 2018). Researchers have utilized numerous approaches to describe service innovation (Carlborg *et al.*, 2014; Mele *et al.*, 2014), which we will briefly review and update (see Table 1 for an overview). For more in-depth discussions, we recommend excellent overviews provided by Carlborg *et al.* (2014), Witell *et al.* (2016), Snyder *et al.* (2016) and Helkkula *et al.* (2018). For our review and update, we draw on the accepted method of classifying service innovation research based on three service development approaches: assimilation, demarcation and synthesis (Coombs and Miles, 2000; De Vries, 2006; Droege *et al.*, 2009).

The *assimilation approach* is an extension of the traditional economic logic in which goods, delivered by firms, are seen as central to value creation (Toivonen and Tuominen, 2009; Barras, 1986, 1990; Utterback and Abernathy, 1975). Consequently, this approach uses service innovation theories, concepts and methods similar to those developed for manufacturing contexts (Coombs and Miles, 2000; Drejer, 2004; De Vries, 2006; Nijssen *et al.*, 2006). Stated alternatively, this approach suggests that knowledge of product

	Assimilation	Demarcation	Synthesis	Experiential	Ecosystemic
Description	Service innovation as an extension to product innovation suggests that knowledge of product innovation holds for all types of offerings – new products and services	Service innovation/innovation in service industries is unique (Rubalcaba *et al.*, 2012) and needs to be treated differently from product or technological innovation	Creating an offering not previously available to the firm's customers – either an addition to the current service mix or a change in the service delivery process – that requires modifications in the sets of competencies applied by service providers and customers	Service innovation as the subjective, individual experience, determined by customers' sensemaking	Service innovation occurs within nested social and economic systems, enabled and constrained by institutional arrangements that (in turn) are shaped by service innovation
Focus	Technological view of service innovation that assumes that new technologies are the primary driver for the development of novel offerings (products and services)	Novel services and solutions that entail some form of change for either the firm or customers	The active role of customers and other actors in the service development process	Actors' experiences with service innovation determine innovation (process and outcome) as radical/incremental and positive/negative	Collective and combinatorial innovation processes involving broad sets of actors within and across service ecosystems
Service innovation as	Outcome	Outcome	Process and outcome	Experience	Institutional change
Value creation	Value-in-exchange: created by the firm and delivered to the customer	Value-in-exchange: created by the firm and delivered to the customer	Value-in-use: application of knowledge and integration of other resources for the benefit of another actor	Value-in-experience: phenomenological (experientially determined) value: new and valuable experiences that are individually experienced but socially cocreated	Value cocreation and service ecosystem viability: novel outcomes, patterns and service ecosystem properties as a result of emergence and intentional service ecosystem design

(*continued*)

Table 1.
Approaches to service innovation

	Assimilation	Demarcation	Synthesis	Experiential	Ecosystemic
Level of analysis	Firm-centric	Firm-centric	Firm-customer relationship	Firm-customer relationship	Nested ecosystems
Key references	Ko and Lu (2010), Barras (1986, 1990), Utterback and Abernathy (1975)	Hertog *et al.* (2011), Agarwal and Selen (2009)	Carlborg *et al.* (2014), Drejer (2004), Ordanini and Parasuraman (2011)	Vargo and Lusch (2008), Rubalcaba *et al.* (2012), Helkkula *et al.* (2012)	Lusch and Nambisan (2015), Barrett *et al.* (2015), Vargo *et al.* (2015, 2020, 2023a), Chandler *et al.* (2019), Vink *et al.* (2021)

Source(s): Table by the authors

Table 1.

innovation holds for all types of offerings – new products and services (Witell *et al.*, 2016). It draws from a technological view of innovation and assumes that new technologies contribute to the development of novel offerings (Coombs and Miles, 2000). Ko and Lu (2010), for example, define service innovation as "technology-based inventions, driven by the emergence of new markets or new service opportunities" (p. 164). Similarly, Snyder *et al.* (2016) suggest that the assimilation approach aligns with the Schumpeterian view of innovation, as it describes innovation as an outcome that is new to the world and creates exchange value for the firm (Schumpeter, 1934).

Contrastingly, the *demarcation approach* argues for the unique properties of service and points to the need for a separate set of theories and measurement instruments. This approach to service innovation suggests that innovation for service contexts and industries is unique (Rubalcaba *et al.*, 2012) and needs to be treated distinctly from product or technological innovation (Hertog *et al.*, 2011; Agarwal and Selen, 2009). It focuses on novel services and solutions that entail some form of change for either firms or customers (Witell *et al.*, 2016). In the demarcation approach, services are commonly identified as intangible, heterogeneous, inseparable and perishable (IHIP) (Zeithaml *et al.*, 1985). They are assumed to have inferior characteristics compared to the tangible, standardized, separatable and storable features of goods (Vargo and Lusch, 2004b). Despite the outwardly opposing viewpoints of the assimilation and demarcation approaches, both are guided by a production logic in which goods take precedence over services and a focal actor (e.g. firm or entrepreneur) is perceived to unidirectionally deliver value to customers (Vargo and Lusch, 2004a).

The *synthesis approach* builds on a multi-dimensional understanding of service that draws from both manufacturing and service logic (Carlborg *et al.*, 2014; Rubalcaba *et al.*, 2012). While Schumpeter (1934) argued that the process of developing a new offering should be differentiated from its commercialization, the synthesis approach views service innovation as both the development process and its marketized outcome (Witell *et al.*, 2016). Ordanini and Parasuraman (2011), for instance, define service innovation as "an offering not previously available to the firm's customers—either an addition to the current service mix or a change in the service delivery process—that requires modifications in the sets of competencies applied by service providers and customers" (p. 5). Similarly, Carlborg *et al.* (2014) offer an integrated framework that includes the assimilation and demarcation approaches, extended by the role of customers as cocreators in the innovation process.

Indeed, one critical characteristic of the synthesis approach is the active role of customers and other actors in service development, which was mostly neglected in the study of product innovation in manufacturing (Drejer, 2004; Droege *et al.*, 2009). A synthesis approach further suggests that service innovation includes not only interactions with customers but also employees, business owners, alliance partners and communities who are involved in the cocreation of new and improved service offerings, service processes, service business models (Snyder *et al.*, 2016) and new regional models that prioritize service provision over the production of goods by transforming entire territories toward knowledge-based economies (Lafuente *et al.*, 2019). Because the synthesis approach reconciles the goods versus services distinction (Gallouj and Savona, 2009; Rubalcaba *et al.*, 2012), it aligns more closely with S-D logic's understanding of service (Vargo and Lusch, 2004a; Lusch and Nambisan, 2015).

Recently, Helkkula *et al.* (2018) reflected on the conceptualization of service innovation and demonstrated that outcome (assimilation, demarcation) and process-based (synthesis) approaches have been more pronounced in the academic discourse while experiential and systemic conceptualizations of service innovation have become increasingly central for firms and other actors seeking to cocreate phenomenologically-determined value in service ecosystems. The *experiential approach* defines service innovation as the subjective, individual experience determined by customers' sensemaking and social contexts (Helkkula and Holopainen, 2011). This approach has attracted increasing interest because of its focus on customer and user experiences that play a critical role in value cocreation (Rubalcaba *et al.*, 2012).

However, this emphasis on customers' participation in cocreation must be distinguished from, and does not necessitate, co-production (i.e. the active customer role in the ideation or production of an innovation). Rather, it aligns with S-D logic's axiomatic assertion that "value is always uniquely and phenomenologically determined by the beneficiary" (Vargo and Lusch, 2008, p. 7). Stated differently, the actors' experiences with service innovation determine the innovation (process and outcome) as radical or incremental and positive or negative (Helkkula *et al.*, 2012, 2018).

The *ecosystemic approach* informed by S-D logic we introduce next highlights the encompassing nature of service innovation by emphasizing that all value cocreation and innovation processes occur within service ecosystems in which resource-integrating actors are connected by, and shape, institutional arrangements (Vargo *et al.*, 2015). This approach is deeply embedded in S-D logic's narrative (Vargo and Lusch, 2016) and, as we will explain in detail, provides a transcending perspective to *accommodate and reconcile different service innovation approaches* (Helkkula *et al.*, 2012).

2.2 Service-dominant logic as a metatheoretical framework for service innovation

Over the last decade, researchers have shown an increasing and substantial interest in service innovation (see Gustafsson *et al.*, 2020). Based on this interest, the resulting work should have reached a mature state with a relatively stable theoretical foundation. However, a coherent theoretical framework that captures all service innovation facets has been lacking. An overview of articles published on service innovation in business, management and accounting since 2005 (extracted from the Scopus database in December 2022) confirms both the growing interest in service innovation and the lack of a broadly accepted theoretical framework. However, one-third of all studies on service innovation now (as of 2022; see Figure 1) use S-D logic as a metatheoretical framework to either inform their empirical analysis (e.g. Iden *et al.*, 2020; Peltier *et al.*, 2020) or to develop new S-D logic-informed midrange theory, including service design (e.g. Vink *et al.*, 2021; Sudbury-Riley *et al.*, 2020; Grenha Teixeira *et al.*, 2017) and service innovation process frameworks (e.g. Chandler *et al.*, 2019; Sjödin *et al.*, 2020; Häikiö and Koivumäki, 2016).

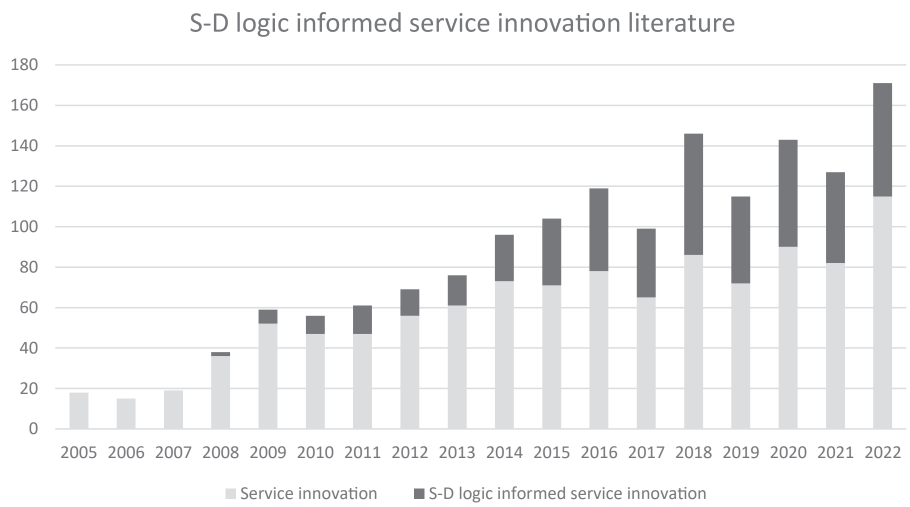

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Figure 1. Evolution of S-D logic informed service innovation literature

Hence, it is safe to state that S-D logic is beginning to provide a *coherent and unifying metatheoretical foundation for service innovation*. One characteristic of a general theoretical perspective or metatheory is its axiomatic assertions (Vargo and Lusch, 2017). While these cannot be definitively verified, directly, metatheoretical frameworks provide a fundamental logic that offers an alternative perspective for understanding, if not resolving, issues in existing midrange theories. That is, metatheory can potentially *reconcile and subsume lower-level theories* and perspectives to encourage scholars to look beyond their immediate scope and to conceive how their work may contradict but also *relate* to other bodies of work.

S-D logic reorients service innovation from a linear, firm-centric process to one that is more complex, dynamic and ecosystemic (Vargo *et al.*, 2015). Specifically, an S-D logic perspective emphasizes the dynamic integration of resources, value cocreation and the central role of institutions (Vargo *et al.*, 2015) in coordinating actor interactions and shaping service ecosystems (Vink *et al.*, 2021; Mele *et al.*, 2018).

Foundational to this view is the definition of service (singular), not as a unit of output (often conveyed in the plural form, services) but as the basis of all economic and social exchange (Vargo and Lusch, 2004a). Also critical is the recognition of two general types of resources: operand (i.e. those requiring action of other resources to generate benefit) and operant (i.e. those capable of acting on other resources to provide value). Service involves the application of operant resources (i.e. skills and knowledge) by one actor to benefit another, and goods reflect a form of *indirect service*, whereby an operand resource serves as a distribution mechanism for service (Vargo and Lusch, 2004a). The service ecosystem perspective on innovation encompasses tangible and non-tangible value propositions (Lusch and Nambisan, 2015) yet underlines the importance of operant resources (Vargo *et al.*, 2015). That is, service innovation encompasses innovation in manufacturing and service industries.

For instance, while Tesla is undoubtedly a manufacturing company, its “Over-the-Air” software updates allow the company to remotely replace software in its vehicles, adding new features and improving performance without customers needing to bring their cars into a dealership. This convenient service innovation has significantly improved customer experiences, as it allows Tesla to fix bugs and add new features quickly and seamlessly.

However, these software updates would not be possible without the increased connectedness and use of processors, sensors, screens and memory chips that comprise Tesla's (tangible) hardware. This illustrates that all innovation processes are ultimately service-driven.

The usefulness of any actor's resources in such innovation processes relies on (1) the availability of resources from other actors and (2) the willingness and ability of other actors to engage in exchange and resource integration (Vargo and Lusch, 2011). Lusch and Nambisan (2015) suggest that the design and development of technology-enabled service innovations result from actor-to-actor interaction and resource integration processes. The authors define service innovation as "the rebundling of diverse resources that create novel resources that are beneficial (i.e. value experiencing) to some actors in a given context" (p. 161). As Lusch and Nambisan (2015) explain, such a conceptualization offers several advantages. First, it focuses on the value experienced by a beneficiary rather than on a value-laden output offered by a service provider. Second, it includes the beneficiary as an active participant (i.e. cocreator) of service innovation. Third, it emphasizes access to (as opposed to ownership of) relevant bundles of resources as crucial for service innovation.

Vargo and Lusch (2016) further argue that value cocreation and resource integration processes in and across service ecosystems are enabled and constrained by institutions and institutional arrangements. Institutions are social structures (i.e. rules, norms, symbols, etc.) that guide how actors behave, collaborate and collectively innovate. However, these structures are not given; they emerge and are shaped through actors' behaviors and their innovation efforts (Vargo and Lusch, 2016). The Tesla example shows how the company has shaped infrastructure and industry norms and standards (i.e. institutional arrangements) in alliance with other actors, including other car manufacturers, suppliers, customers and policymakers. These revised institutions, as they have emerged, concurrently guided actors' behaviors in the EV market.

A service ecosystem perspective highlights that all service innovations are grounded in institutional change processes (Lawrence *et al.*, 2009). In fact, Vargo and Lusch (2016) suggest that it is this institutional nature that gives service ecosystems their self-organizing, co-evolutionary and emergent characteristics (see also, Taillard *et al.*, 2016; Vargo *et al.*, 2023a). Specifically, Vargo and Lusch (2016) define service ecosystems as "relatively self-contained, self-adjusting system[s] of resource integrating actors connected by shared institutional arrangements and mutual value creation through service exchange" (pp.10-11). Consequently, service innovation can only be truly understood when institutions and institutional change are considered (Chandler *et al.*, 2019). This holistic perspective of service ecosystems further broadens the scope of service innovation from innovating service offerings and processes to shaping and designing service ecosystems (Vink *et al.*, 2021; Mele *et al.*, 2018).

3. The nature of digital service innovation: a unifying framework

3.1 Defining digital service innovation

Rapid developments in the digital landscape have undoubtedly changed the context for service innovation. Blockchain technology, for example, provides tamper-proof accountability of transactions and increases transparency in service-for-service exchange (Risius and Spohrer, 2017). Big data and AI, on the other hand, enable market actors to depict (and possibly predict) the behaviors of their exchange partners (Hallikainen *et al.*, 2020). By blending distinct lines between the physical and the digital, virtual reality and metaverses can fundamentally transform how people interact and conduct business (Dwivedi *et al.*, 2022; Hennig-Thurau *et al.*, 2023).

Building on prior research, various facets of DSI have been explored, shedding light on both organizational and technological enablers (Troilo *et al.*, 2017), delving into service design within smart product-service systems (Zheng *et al.*, 2018) and developing DSI archetypes within the scope of the sharing economy (Frey *et al.*, 2019). Moreover, the notion of digital twins, serving as extensions to product-service lifecycles, has been introduced as an innovative form of DSI (Tao *et al.*, 2018). The role of DSI is often seen as transformative, marking a departure from established service concepts within industries (Soto Setzke *et al.*, 2023).

At its core, DSI typically involves the application of digital technologies to develop, enhance, or roll out new services. This could manifest as digital enhancements to existing products, or as entirely novel digital services, all geared toward fulfilling customer needs more efficiently, effectively and innovatively (Troilo *et al.*, 2017; Soto Setzke *et al.*, 2023; Opazo-Basáez *et al.*, 2021). The pursuit of DSI is frequently characterized by goals such as improving performance in product-service systems (Tao *et al.*, 2018), creating new business opportunities and business models (Frey *et al.*, 2019) and thereby generating value and gaining competitive advantage (Raddats *et al.*, 2022).

Indeed, while these studies are useful in dissecting, empirically evaluating and testing the processes, drivers and outcomes of DSI in diverse contexts, they are often guided by the earlier introduced assimilation approach. Fundamentally, they lean towards a goods-dominant logic, rather than a service-dominant one, a perspective that may limit the full comprehension and potential of DSI.

In addition, a considerable portion of DSI literature only directs attention to a single focal actor or a group of actors spearheading digital technology-driven innovation processes (Opazo-Basáez *et al.*, 2021; Eckert and Hüsig, 2022; Raddats *et al.*, 2022). Unquestionably, these units of analysis can be useful in advancing comprehension of how digital technology implementation interacts with organizational structures and culture. Nonetheless, research that is solely focused on a single unit (or level) of analysis, by its very nature, overlooks the multifaceted innovation processes that involve a broader network of external stakeholders, such as suppliers, partners and customers. These actors arguably hold significant relevance as the evolution of digital service often hinges on the cocreative efforts of complementary actors (Iden *et al.*, 2020; Kohtamäki *et al.*, 2019; Kolagar *et al.*, 2021; Sjödin *et al.*, 2019; Wiredu *et al.*, 2021). Thus, we argue that adopting a more inclusive lens that captures broader service ecosystems provides a more comprehensive view of DSI dynamics.

Moreover, our reading of the emergent DSI literature points to a prevailing perspective that fast-evolving digital technologies are fundamentally reshaping the nature of service innovation. However, as evidenced by existing DSI studies (e.g. Frey *et al.*, 2019; Tao *et al.*, 2018; Jovanovic *et al.*, 2022), it is not the nature of innovation itself that changes, but rather the institutional context surrounding innovations. Consider, for instance, the success of Apple and Android smartphone platforms. These achievements can only be fully appreciated when perceived as a cocreated innovation process, encompassing a diverse set of actors such as app developers, users, social media influencers, content seekers, platform providers, gig workers, among others. Furthermore, these innovation processes rely on the recombinations of pre-existing technological building blocks, which include but are not limited to, programming languages, audio and video digitalization and compression techniques, radio frequency and memory chipsets, lenses, batteries, etc. Ultimately, understanding these processes in their totality requires considering infrastructures like power generation and distribution, communication networks and social structures. These encompass laws and regulations, cultural and social norms, languages and symbols, among others. This underscores that DSI is both enabled and constrained by the institutional arrangements that give shape to service ecosystems, showcasing the complex and interconnected nature of (digital) service innovation.

Stated alternatively, successful DSI is not just about the creation or the “wholesale adoption of a particular technology, or the ideas behind it, as envisioned by one actor (e.g. a firm)," but "should be understood as an iterative process through which ideas evolve as actors interact, integrate resources, and interpret ideas from their heterogeneous perspectives" (Vargo *et al.,* 2020, p. 530). Adopting such a comprehensive, meta-level viewpoint reveals that DSI, by its very essence, does not diverge from other types of innovation, such as technological, service, product, business model, or market innovation (Coombs and Miles, 2000). Rather, all forms of innovation rest on the application of actors' resources, coordinated by institutional processes that enable service exchange and value cocreation. Thus, we believe it is important to stress that while actors possess agency and some actors may exert significantly more influence than others (Mele *et al.*, 2018; Carida' *et al.*, 2022), innovation should not be oversimplified as a process singularly led by a focal actor. Instead, it diffuses as a process driven by the distributed agency of all relevant actors (Vargo *et al.*, 2020). This perspective highlights the intricacy and collective nature of DSI, while also pointing to the combinatorial evolution process through which it emerges (Arthur, 2009; Vargo and Akaka, 2012; Vargo *et al.,* 2020; Lusch and Nambisan, 2015).

Arthur's (2009) work describes combinatorial evolution processes as the underlying mechanism for technological innovation. Nonetheless, combinatorial evolution processes are also the underlying mechanism for institutional change. As Thornton and Ocasio (2008, p. 117) point out, institutional change follows the same combinatorial principle. Actors "hop and bridge" from one institutional logic to another to combine institutional elements as part of collaborative processes that reflect on and redefine the basis for their collective action.

Technological and institutional change are entangled since all technological advancements are intrinsic parts of dynamic social systems. Institutions and technologies cannot be viewed in isolation from each other as technologies need to be understood as "assemblage[s] of practices and components" (Arthur, 2009, p. 28) that only become technologies as they become institutionalized (i.e. become perceived as useful; see also Mokyr, 2011).

However, what distinguishes DSI from other forms of innovation is one unique trait—the high degree of resource liquification. Resource liquification involves decoupling information from the technologies that store, transmit, or process them. Digitalization increasingly enables actors to exchange in "liquefied" or "dematerialized" forms (Normann, 2001), enabling service provisions without the need for physical products and face-to-face interactions. Relatedly, digitalization enables greater resource density, the (re)combination of resources mobilized for a particular purpose, to take place at greater speed with wider geographical spread. In other words, digital technologies help liquefy resources and heighten resource density through more efficient and effective service exchange. Arguably, liquified service exchange highlights that service is always the primary unit of exchange and underlines the systemic nature through which resources are attained and integrated.

We conclude that:

> Digital service innovation (DSI) is based on combinatorial evolution processes in which preexisting technologies and institutions are (re)combined through actors' collective and cocreative efforts. Digital technologies aid combinatorial evolution processes by increasing the speed, reducing the cost, and expanding the number of new legitimized combinations of service provisions, enabling new resource integration and value cocreation processes.

Specifically, as we will show in the remainder of this paper, altering intangible algorithms, bits and bytes is often easier than altering tangible objects, which *increases the speed for novel outcomes (e.g. service, business models, markets) to emerge*. Digitalization reduces the challenges of coordinating innovation processes because algorithmic and increasingly *distributed governance permits low-cost exchange* among large numbers of actors. Finally, digitalization greatly facilitates *symbiotic design,* emphasizing that multiple actors collectively shape the service ecosystems of which they are part.

Whereas, on the surface, these three mechanisms appear novel and distinct to the context of DSI, we will demonstrate that their underlying logic holds for both digital and traditional (physical) innovation processes. In fact, systems thinking—thinking in terms of self-organizing patterns (i.e. emergence), shaped by interconnected actors (i.e. through distributed governance) and their attempts to "change existing situations into preferred ones (i.e. design (Simon, 1988)) has become commonplace in much of the natural sciences (Capra and Luisi, 2014) and provides a solid foundation to (re)conceptualize (digital) service innovation.

3.2 Emergence as the foundation of (digital) service innovation

Emergence is "a phenomenon that arises from the relationships among existing system's elements but that is qualitatively different from and irreducible to them" (Vargo *et al.*, 2023a, b). The introduction of varied digital technologies, platforms and infrastructures has enabled the emergence of more open and fluid structures, processes and value-creation activities (Nambisan, 2017). These structures, processes and value creation activities "arise, often unpredictably, from interactions within complex and dynamic contexts" (Vargo *et al.*, 2023a, p. 2). Specifically, three unique characteristics of digital technologies—the (1) reprogrammability, (2) homogenization of data and (3) self-referential nature (Yoo *et al.*, 2010)—facilitate more porous and fluid spatial and temporal boundaries of service exchange as well as greater dynamism in the locus of innovation and entrepreneurial agency (Nambisan *et al.,* 2019; Nambisan and Luo, 2021).

Whereas reprogrammability makes it possible to alter combinatorial elements (i.e. to adjust or replace technologies with failing institutional legitimacies), homogenization permits liquified resources to be "stored, transmitted, processed, and displayed using the same digital devices and networks" (i.e. allows liquified resources to travel with ease due to institutionalized interfaces and standards; Yoo *et al.*, 2010, p. 726). Self-reference points to the dependency of digital technologies and processes on complementary digital technologies or, stated alternatively, to the phenomenon that new digital technologies commonly lead to the creation of other digital technologies. That is, as digital technologies become institutionalized, they increasingly offer themselves as building blocks for further combinatorial processes.

These unique characteristics of digital technologies undoubtedly provide the ability to speed up innovation processes by creating greater resource density, which geographically dispersed actors can use to facilitate their combinatorial evolution processes. We see such network effects in AI-powered traffic navigation systems, music streaming services and Internet search engines which many actors continuously contribute to improving. These network effects, in turn, offer heightened value-in-use for all actors in the service ecosystem (Sivarajah *et al.*, 2017; Kohtamäki *et al.*, 2019).

Digital platforms allow broad sets of actors to participate in service ecosystems and contribute to resource (re)combinations and value cocreation in novel and dynamic ways. For instance, the integration of AI-informed humanoid chatbots results in novel service interactions as broad sets of human and non-human actors engage in efforts to enable, enrich, or prevent their use. Peters (2016) describes the outcome of such resource (re)combinations and value cocreation processes as "emergence." She argues that novel and unique outcomes are often neither fully "reducible to nor determined by the attributes of their base resources" since the emergent "whole is more than the sum of its parts" (Peters, 2016, p. 3003).

The accounting software provider Xero offers an interesting case for the emergent nature of DSI. After opening its APIs to a handful of developers in 2009, the Xero solution now includes over 1,000 connected apps, attracting 2.7 million global business customers to the cloud platform. The Xero App Marketplace makes interconnected apps created by third-party developers available to help small businesses with everything from cash flow management to moving sales online. This example powerfully demonstrates that DSI is always orchestrated by broad sets of actors. The open system architecture allows for complementing service providers (e.g. app developers) to co-develop new digital services on top of the Xero platform. This has resulted in emergent innovation outcomes that go beyond what Xero could envision. For instance, an app called Aider can now access the Xero database and answer verbal questions such as "What's our revenue today." This app was created by (loosely connected) third-party developers because Xero allows dispersed actors to jointly create value through complementary service provisions.

This example further illustrates that DSI reflects the dynamic interplay of resource (re) combination processes resulting in novel and frequently unanticipated outcomes (Vargo *et al.*, 2023a) that are neither fully controllable nor manageable by any one focal actor. Institutional frictions commonly motivate novel resource combinations (Vargo *et al.*, 2020). These frictions can result from sociotechnical developments or materialize when actors apply the institutions of one context to another context (Wieland *et al.*, 2017). The emergence of peer-to-peer driving services, such as Uber and Lyft, was not only enabled by institutional frictions between riders and taxi drivers (e.g. dirty cars, longer than necessary routes to drive up fares) but such peer-to-peer services can now be found in many contexts (e.g. food delivery, car charging).

That is, all innovation processes, including DSI, need to be viewed as dynamic, non-probabilistic and multi-directional processes generating novel outcomes and novel ecosystem properties (i.e. institutional arrangements) (Vargo *et al.*, 2023a) through the (re)combination of technological and institutional building blocks. The main difference is that in DSI, many of these building blocks are available in "liquefied" or "dematerialized" forms (Normann, 2001), providing service-exchanging actors with opportunities for greater resource density.

3.3 Distributed governance in (digital) service innovation

Viewing DSI as an emergent process in which broad sets of actors (re)combine both the resources and the institutional arrangements that guide these resource integration processes in novel ways raises the question of how actors can coordinate emergence in service innovation processes. In pre-digital times, hierarchical organizations with top-down decision-making processes were, in many contexts, seen as the preferred way to coordinate economic actors and their activities. Consequently, much scholarly discussion on DSI has seemingly accepted that one central actor (e.g. a manufacturer, Raddats *et al.*, 2022) or a consortium of actors (Soto Setzke *et al.*, 2023) can drive and orchestrate DSI. As noted, however, increasing digitalization has significantly heightened the number of touchpoints at which connections and exchanges occur (as the Xero cloud service example illustrates). In line with S-D logic's ecosystems perspective, this coordination across many actors and touchpoints cannot be achieved by the top-down decision-making of a central actor but only through broadly shared institutional arrangements of systemic actors. Digitalization makes these governance mechanisms that coordinate efforts of dispersed, decentralized actors particularly salient (see, for example, Eckhardt *et al.*, 2019).

Indeed, digitalization highlights the potential of distributed governance mechanisms, which facilitate emergence and allow for collective and more democratic decision-making processes (e.g. Jovanovic *et al.*, 2022). For instance, the rising use of blockchain technology has led to a growing number of decentralized digital platforms that are governed less by platform owners (such as Airbnb, Uber, Amazon and others) and more by collective efforts of developer and user communities (Chen *et al.*, 2021). Blockchain does not require centrally located and trusted entities (e.g. platforms, banks, notaries, etc.) to govern interactions among actors. Instead, quality standards are embedded into the technical architecture itself by standardizing the terms of each interaction, for example, through smart contracts (Schmeiss *et al.*, 2019) and other boundary resources (i.e. digital interfaces that specify how actors connect, interact and collaborate; Eaton *et al.*, 2015). These built-in standards ensure that transactions are executed correctly.

Boundary resources allow actors to access digital ecosystem infrastructures and resources while co-developing new solutions (i.e. new building blocks for combinatorial processes) on top of them (Hein *et al.*, 2019). For instance, blockchain developers use existing infrastructure on Ethereum and open code (developed by others) to build newly decentralized (D-)apps. This can accelerate DSI and simultaneously reduce transaction costs. DSI depends on collective decision-making processes to achieve efficiency and legitimacy within a service ecosystem. Arguably, in digital service ecosystems, boundary resources (interfaces to collaborate) and built-in standards that are embedded in the technical architecture replace quality control and trust that otherwise would be ensured through middlemen, such as brands, notaries, banks, governments and others.

While a strong focus on central actors and their top-down decision-making processes has historically masked that governance in service exchange has always been shaped by the institutional work of broad sets of actors, new digital technologies make the fact that governance mechanisms are formed through dynamic and iterative processes of aligning institutions particularly salient. However, while such new forms of governance undoubtedly deserve scholarly attention, even in digital service ecosystems, the fact that all innovation is grounded in the (re)combination of technological and institutional building blocks endures.

3.4 Symbiotic design as an engine for (digital) service innovation

If one accepts that DSI is governed collectively, design processes that nurture DSI must also be viewed (eco-)systemically. A service ecosystems perspective overcomes perceptions of firms and entrepreneurs as actors that can singlehandedly drive DSI in isolation. However, this perspective does not question the ability of individual actors to play important roles in DSI. Work by Chandler *et al.* (2019) suggests that innovation in service ecosystems cannot be managed by one focal actor but can be influenced collectively by changing, disrupting, or maintaining the institutional arrangements that guide innovation processes.

We refer to these collective efforts as *symbiotic design*. Recent work in cyber-physical systems (e.g. Skowroński, 2019) and sustainable systems design (e.g. Sánchez Ruano, 2016) use this term to explain actors' complementary efforts to influence service ecosystem properties. Symbiotic design is particularly salient in digital service ecosystems. For instance, in Xero's cloud solution, the cloud platform provider depends on the design efforts of other service providers (e.g. software developers, consultants, intermediaries and business customers) to extend, customize and (re)combine the platform service (Wu *et al.*, 2022).

To navigate this complex interplay of various actors co-designing a platform service, cloud service ecosystems need to be shaped to balance structural flexibility and integrity in a way that facilitates value cocreation (Lusch and Nambisan, 2015). Structural flexibility refers to how easily actors collaborate within an ecosystem, while structural integrity describes the relationship between the participating actors and their degree of coupling (Tilson *et al.*, 2010). This understanding points to the critical role of institutions and institutional arrangements in symbiotic design. Indeed, Vink *et al.* (2021) argue that the design material in service ecosystems are institutions and institutional arrangements as they guide actors' desired forms of value cocreation (see Vargo and Lusch, 2017; Edvardsson *et al.*, 2011).

Consider metaverses, which some view as the most disruptive DSIs of our time (Dwivedi *et al.*, 2022). These 3-D virtual worlds allow users, in the case of Decentraland, for instance, to buy, create and explore Nonfungible Token (NFT)-based plots of virtual land using cryptocurrencies. This illustrates that a wide range of institutions need to change for metaverses to gain institutional legitimacy. For instance, the institutions that define possessions (NFTs instead of physical land plots), exchange (digital instead of stateregulated currencies), how we experience the world (through VR headsets), and ultimately, what we perceive as *the* world need to be negotiated to become aligned.

Chandler *et al.* (2019) argue, in the context of a large-scale IoT project, that rather than focusing too narrowly on technological developments in innovation processes, norms, rules and beliefs that support new ideas and technological solutions need to be revised and reconfigured. Stated alternatively, DSI requires both new digital technologies and the institutions that lead actors to perceive these technologies and their combinations as useful.

Returning to the metaverse example, the technology that enables the creation of metaverses is fast evolving, with VR headsets, haptic gloves and extended reality augmenting users' immersive experiences (Dwivedi *et al.*, 2022). Yet, Mark Zuckerberg predicts that it will still take five to ten more years for metaverses to fully function. Despite promises, it is unlikely that in the short run, one will be able to take their avatar, land, buildings and most other unique digital possessions (e.g. clothing, cars and furnishings) between universes. This is because there are some intractable institutional complexities, including competitive issues, challenging technological standardization and different "digital cultures" in various virtual worlds (Belk *et al.*, 2022). Hence, symbiotic design efforts to navigate DSI must account for the shaping of new institutional structures that allow humans, businesses and other actors to interact in novel ways.

This premise holds in digital and physical service ecosystems. Take, for instance, collective design efforts to transform service ecosystems to accommodate more sustainable and circular business practices. While design principles to support an environmentally sustainable future (e.g. eliminating waste and pollution from the outset, keeping products and materials in use at their highest value and regenerating natural systems) have been established for over three decades, their broad adoption is still lacking. Arguably, the slow diffusion of such innovations can be explained by deeply rooted path dependencies in service and business model designs (Fehrer and Wieland, 2021).

We conclude that although digital technologies can be transformed quickly, through reprogrammability and high degrees of interoperability, practitioners must always consider prolonged institutional work processes (Lawrence *et al.*, 2009). Even in the digital age, diffusion of service innovation (Vargo *et al.*, 2020) or institutionalization of digital technologies often takes significant time to gain broad legitimacy. As Hinings *et al.* (2018, p. 57) state, "Despite the more rapid development of technology, there is variation in diffusion and new technologies do not necessarily become legitimated more rapidly. Institutional theory suggests that institutional changes are likely to be over considerable periods of time and regulators and policymakers can still work with 5–10 years time horizons."

4. Discussion and managerial implications

This paper provides a unifying theoretical framework by synthesizing the latest work on S-D logic with insights from emerging research that centers on ecosystemic service innovation (Lusch and Nambisan, 2015; Barrett *et al.*, 2015; Chandler *et al.*, 2019; Vargo *et al.*, 2023a). We explicate why innovation processes that result in advanced digital technologies, such as cloud computing, AI, blockchain and metaverses, require systems thinking—thinking in terms of self-organizing and co-evolutionary patterns. However, we also point to the fact that while increased academic and practitioners' interest in service innovation has coincided with the proliferation of such advanced technologies, this does not mean that the fundamental nature of service innovation has changed. Service innovation has always been, and continues to be, a process based on the combinatorial evolution of institutional building blocks that emerge through continual processes of enacting value cocreation practices and includes sensemaking, interactions and negotiations and even political struggles among broad sets of actors.

This reconciliation highlights how seemingly disparate perspectives—product versus service innovation and traditional (physical) versus digital service innovation—can be reframed at a higher level of abstraction without negating observed differences between innovation types nor diminishing the value of existing work at their respective levels of abstraction. It encourages scholars to look beyond their immediate focus, to contemplate how their work might both conflict with and relate to other work. We submit that this heightened awareness can counteract increasing academic silos (Moorman *et al.*, 2019) and theory fragmentation (Vargo and Lusch, 2017; Vargo *et al.*, 2023b) [1], the central concern of this Special Issue.

Our proposed service innovation framework encapsulates service innovation aspects in digital and physical realms, including their combinations. Specifically, it portrays DSI as a dynamic, relational process where no single actor can dictate outcomes. The framework's foundation rests on three innovation mechanisms: *emergence, distributed governance* and *symbiotic design*, applicable regardless of whether innovation processes involve technological developments, new (digital) services, or new markets. By extension, our framework (see Table 2 for an overview) highlights that these three elements are all grounded in institutional and combinatorial processes of connected actors as they integrate resources and cocreate value.

This (re)conceptualization of DSI challenges traditional mental models that view service innovation as fully "manageable" by a focal actor. Instead, it requires practitioners to rethink their roles in service innovation processes. Specifically, we point to four important strategic considerations (summarized in Table 3) to influence—not manage—DSI by adopting an ecosystemic mindset.

4.1 Taking advantage of institutional frictions

By its very nature, a service ecosystem framework for (digital) service innovation points to institutional complexities, contradictions and voids. As Sewell (1992) argues, institutional change can only be understood when society is viewed as "multiple, contingent and fractured," as this nested and overlapping conceptualization of society allows actors to apply and recombine their institutions across a wide range of circumstances. These institutional complexities, contradictions and voids move the identification and evaluation of institutional elements and frictions to the heart of any intentional efforts to influence innovation processes.

Institutional frictions, for example, can indicate that resource combinations are falling out of favor or that new combinations have not gained institutional legitimacy. Napster, for example, the pioneering music streaming service launched in 1999, fundamentally shaped the music industry, even though it had to cease operations in 2001 after losing a wave of lawsuits related to copyright infringements. While Napster is clearly a failure when viewed through a micro-level and focal-actor lens, other actors, such as Spotify, took advantage of the frictions created by Napster and participated in the shaping of institutions and institutional arrangements that could accommodate emerging novel patterns of service exchange, such as music streaming, music sharing and open code that are still in use today in music platforms.

As stated, our framework overcomes perceptions of firms and entrepreneurs as actors who singlehandedly drive innovation in isolation. However, it does not question the ability of single actors to play critical roles in service innovation processes. Practitioners can use institutional frictions as catalysts to identify solutions to new and emerging problems. This requires applying oscillating foci across customer, company, market and society levels (Akaka *et al.*, 2023; Chandler and Vargo, 2011) to gather insights about institutional change and combinatorial evolution processes.

4.2 Embracing emergence

Understanding nested sociotechnical ecosystems (Akaka *et al.*, 2023; Chandler and Vargo, 2011; Simon, 1996) requires an identification of the system properties that emerge from the interactions between the different components rather than being directly caused by any one

Elements of service innovation	Definition	Manifestation in the digital context	Updated consideration for (digital) service innovation
Emergence	A process that describes how phenomena (e.g. structures, processes and value cocreation activities) arise, mostly unpredictably, from the relationship among a system's elements. This includes the elements' interactions within a complex and dynamic context (Vargo *et al.*, 2023a)	• Digitalization is marked by resource liquification (i.e. the decoupling of information from the actors and tangible items that have conventionally carried and stored them) • Reprogrammability, homogenization of data and self-referential nature (Yoo *et al.*, 2010) enable more open, porous and fluid spatial and temporal boundaries • Digital service platforms allow broad sets of actors to contribute to resource (re) combinations and value cocreation in novel and dynamic ways • Digitalization accelerates combinatorial evolution among geographically dispersed actors and enables greater resource density, hence heightening the number of novel outcomes	All innovation processes, including DSI, need to be viewed as dynamic, non-probabilistic and multi-directional processes generating novel outcomes and novel ecosystem properties (i.e. institutional arrangements (Vargo *et al.*, 2023a) through the (re) combination of technological and institutional building blocks)
Distributed governance	Relates to the coordination mechanisms of actors within a service ecosystem to reduce the risk of uncertainty, establish commonly agreed-upon processes to prevent or resolve conflict (Spohrer *et al.*, 2008) and support the viability and performance of the service ecosystem (Vargo and Lusch, 2017)	• Digitalization allows for decentralized governance mechanisms to coordinate the efforts of dispersed actors across increasing numbers of touchpoints • Digital technologies (i.e. distributed ledgers) allow for collective and more democratic decision-making (Jovanovic *et al.*, 2022) • Quality standards programmed into the algorithms (i.e. crypto-trust) make digital interactions less reliant on trusted entities (e.g. brands, notaries, banks, governments, etc.) (Chen *et al.*, 2021)	Mutual value creation through service exchange and innovation has always been enabled and constrained by agreed-upon governance mechanisms and collective (potentially democratic) decision-making processes. Digital technologies, however, facilitate the use of decentralized mechanisms that reduce reliance on traditionally trusted actors

(continued)

Table 2.
S-D logic informed conceptualization of (digital) service innovation

Elements of service innovation	Definition	Manifestation in the digital context	Updated consideration for (digital) service innovation
Symbiotic design	Refers to the complementary efforts to change service ecosystem properties (service, resources, actors, institutional arrangements). Institutional arrangements are the "design material" in symbiotic design processes (Chandler *et al.*, 2019; Vink *et al.*, 2021)	• Digital service ecosystems make the complementary design efforts of various actors (e.g. software developers, consultants, intermediaries and business customers) particularly salient • Digital technologies can be (re) combined and (re) designed quickly. However, institutional change to legitimize these technologies and make them useful require considerable periods of time	Symbiotic design efforts to navigate service innovation must consider the shaping of new institutional structures that facilitate novel interactions, powered by digital technology, among humans, businesses and other actors

Source(s): Table by the authors

Table 2.

component (Vargo *et al.*, 2023a). These emergent properties can provide insights into the underlying issues, gaps, or redundancies that drive innovation processes. For practitioners, this means a shift in mindset from a top-down, control-oriented approach to a more adaptive, flexible and decentralized approach. For instance, Sjödin *et al.* (2020) argue for a stepwise and iterative approach that breaks complex sociotechnical ecosystems into smaller, more manageable parts, leveraging modularity and digital boundary objects (see also, Cenamor *et al.*, 2017). The authors suggest that to fully exploit digital technologies (e.g. AI, analytics, virtual prototyping and operational process simulation) for service innovation, a culture of experimentation, exploration and fast-fail approaches is essential (Sjödin *et al.*, 2020).

This aligns with Norman and Stappers's (2015) understanding of design as a process in complex sociotechnical systems that commonly satisfices rather than optimizes. The authors refer to design as "muddling through." Similar to an effectual approach (Sarasvathy, 2001), "muddling through" means acting opportunistically, taking whatever action is possible at the moment. "Small steps are often supported, as they do not ignite passions (i.e. cause institutional frictions) as much as large ones. Moreover, success with small steps is useful in gaining support for future often larger steps, whereas failure of a small step does not lead to failure of the entire effort" (Norman and Stappers, 2015, p. 91).

4.3 Ensuring high degrees of interoperability

Because DSI is grounded in the mixing and matching of institutional and technological building blocks, it is essential that practitioners promote network structures that facilitate this mixing and matching. More specifically, practitioners need to engage in aligning not only IT standards and digital compatibilities but also the regulative, normative and cultural elements (Scott, 2013) that are foundational to DSI. Such efforts might focus on promoting broad interoperability through the shaping of laws, regulations and social norms. Lime, for example, the dockless transportation rental company, actively negotiates with administrators of cities and universities around the world to align on acceptable ways to store scooters and bikes so that the activities of its clients do not interfere with those of people with disabilities or the public in general (e.g. blocking sidewalks or emergency exits).

Table 3. Strategic considerations for practitioners to influence (digital) service innovation

	Taking advantage of institutional frictions	Embracing emergence	Ensuring high degrees of interoperability	Fostering and incentivizing symbiotic design
Explanation	Identifying institutional frictions in complex adaptive service ecosystems requires a dynamic and adaptive approach to problem-solving	Embracing emergence in complex adaptive service ecosystems requires a shift in mindset, from a top-down, control-oriented approach to a more adaptive, flexible and decentralized approach	Ensuring high degrees of interoperability for DSI requires an open and collaborative approach with low hierarchies and the potential for democratic decision-making	DSI requires collective effort and a collaborative and supportive environment, where stakeholders are recognized, trained and supported in the symbiotic design process
Selected strategic considerations	• Analyzing and mapping the system as a whole, rather than focusing on individual components or processes to see potential for DSI. This may involve mapping the system and identifying the key components and interdependencies, as well as the formal and informal rules, norms and regulations that govern the interactions within the system (e.g. work on ecosystem mapping (Talmar *et al.*, 2020) and giga-mapping (Sevaldson, 2017)) • Applying oscillating foci on customer, company, market and society levels, when gathering insights (Chandler and Vargo, 2011; Akaka *et al.*, 2023) • Real-time sensing, using data and analytics to identify emerging trends, patterns and feedback loops	• Identifying emergent properties, which are properties of the system that emerge from the interactions between the different components, rather than being directly caused by any one component (Vargo *et al.*, 2023a). These emergent properties can provide insights into the underlying issues, gaps, or redundancies that have the potential to drive DSI • Fostering a culture for experimentation (Sjödin *et al.*, 2020) and experimenting in real-world settings (e.g. living labs (Hossain *et al.*, 2019)), using agile and iterative approaches to adapt and refine their value propositions over time (Rodríguez *et al.*, 2019) • Seeking out diverse perspectives and ideas, creating opportunities for cross-disciplinary collaboration and promoting a culture of trust, inclusivity and open-mindedness	• Developing partnerships and resource sharing with other organizations, including customers, suppliers, and industry associations to facilitate interoperability and collective innovation efforts • Using open standards, including APIs, service-oriented architecture (SOA), cloud-based infrastructure, and others to enable different IT systems, platforms and technologies to communicate and work together seamlessly (Eaton *et al.*, 2015) • Implementing data governance frameworks, establishing data standards and protocols and using data encryption and other security measures (Chen *et al.*, 2021)	• Fostering a culture of collaboration where stakeholders feel comfortable sharing their ideas and perspectives and where collaboration and teamwork are valued • Providing access and facilitating knowledge sharing (e.g. open code) among stakeholders (e.g. complementors) to create opportunities to learn from each other and share best practices (Wu *et al.*, 2022) • Providing financial incentives, such as revenue sharing or access to funding, providing recognition, recommendations and visibility for innovative solutions (create win-win situations)

Source(s): Table by the authors

When aligning digital touchpoints, practitioners also need to align technological standards that "enable, constrain and coordinate numerous actors' actions and interactions in ecosystems, fields or industries" (Hinings *et al.*, 2018, p. 54). While interoperability has always been important for service innovation, standards for digital technologies have, as stated, dramatically increased the speed with which actors and devices across the globe can connect.

4.4 Fostering symbiotic design

Finally, (digital) service innovation benefits from deliberate collective efforts and purposefully orchestrated environments in which stakeholders are recognized, trained and supported as they go through symbiotic design processes. Design science research (Hevner, 2007) is one promising research method that facilitates symbiotic design. It provides an adaptive and flexible tool kit to actively engage different stakeholder groups in innovation processes across system levels. It allows stakeholders to negotiate value propositions and adapt them to meet changing needs and preferences in recursive feedback processes. For example, Sudbury-Riley *et al.* (2020) use design science research to harness customer experiences for an enriched understanding of value cocreation throughout multilevel service processes and across multiple touchpoints between organizations and diverse sets of customers. Design science research and, specifically, action design research (i.e. a subfield of DSR; Sein *et al.*, 2011) can offer normative support to facilitate service innovation (Grenha Teixeira *et al.*, 2017; Sudbury-Riley *et al.*, 2020). Furthermore, methods from game design (Polson and Caceres, 2007; Lukosch *et al.*, 2018) provide rich guidance on how to onboard and engage stakeholders in symbiotic design processes that nurture service innovation.

5. Conclusion

Leveraging the metatheoretical perspective of S-D logic, this paper introduces a comprehensive DSI framework that mitigates the widening gap between traditional and digital service innovation research while offering valuable guidelines for practitioners. Central to this framework is the understanding that all service innovation is emergent, necessitates distributed governance and is informed by symbiotic design. Instead of treating DSI as divergent from traditional service design, this framework demonstrates that digitalization not only aligns with but also affirms the fundamental tenets of S-D logic and its affiliated concept of ecosystemic service innovation.

This perspective helps circumvent the prevalent tendency towards sub-disciplinary fragmentation, typically marked by the emergence of new, separate frameworks and models in response to novel contexts and specific subject matters rather than reassessing core metatheoretical assumptions (Vargo, 2007). While existing midrange theory is indispensable for dissecting, empirically evaluating and testing the processes, drivers and outcomes of DSI, this study provides a reference point for scholars to consider their work within a broader theoretical framing rather than limiting their focus to a narrow research context. S-D logic is applicable across all forms of innovation (e.g. product, service, digital service) and serves as a unifying lens, urging researchers to retain sight of the shared elements across sub-disciplines and contexts.

Within DSI, the increased ability of actors to exchange in "liquefied" or "dematerialized" forms (Normann, 2001) confirms that service is the primary unit of all exchange. The increased geographical reach enabled by digital technologies confirms that service provisions are always networked and systemic. And the increased implementation of openly distributed governance mechanisms confirms that mutual value creation through service exchange always relies on collective governance.

Notes

1. We recognize the existence of alternative theoretical frameworks rooted in different ontologies, where digitization is seen as a distinct class of phenomena. Our goal is not to invalidate these frameworks, but rather to transcend and incorporate them by adjusting the conceptualization and understanding of what is exchanged (for more detail, see Koskela-Huotari and Vargo, 2018). We suggest recalibrating the basis of exchange from value-laden goods to service— a process of resource (material and immaterial) utilization for the benefit of another actor. The framers of S-D logic indeed suggest that it is the nature of digitalization, or "liquification" as termed by Normann (2001), that mandates this re-conceptualization to fully capture its ramifications.

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