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Year: 2024

Version: Published version

Recombining Operant Resources: Integrating Service Design and Service Engineering to Improve Service Innovation

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Abstract

Service design and service engineering are being positioned as facilitators for service innovation, yet the research on these fields is siloed. This conceptual paper proposes integrating service design and service engineering through service-dominant logic and suggests potential positive outcomes for service innovation from this integration. Service design and service engineering are framed as interconnected operant resources for service innovation, using service-dominant logic. Based on the framing, this integration facilitates service innovation by recombining service design and service engineering as resources at three different resource levels. The study contributes to the literature by providing a new conceptualization and an integration framework, which can be applied to recombine service design and service engineering as resources, leading to new service innovations.

Keywords: Service innovation, service design, service engineering, service-dominant logic

1. Introduction

Service innovation (SI) is seen as a key to competitive advantage between companies (Helkkula et al., 2018) and a strategic priority for service research (Ostrom et al., 2015). The question of how to best facilitate SI has been approached from different perspectives in the literature.

In the 1980s new service development (NSD) emerged as a research topic in the discipline of marketing (Johne & Storey, 1998), from the idea that developing services differs from developing physical products, and therefore specific methods and processes for service development were needed. During the same decade and the following one, service engineering (SE) and service design (SD) were also born as research domains exploring how the service development process should take place in practice. The former derives from the research tradition of engineering (Bullinger et al., 2003; Beverungen et al., 2018; Aurich et al., 2010) and the latter from the design research tradition (Joly et al., 2019). These fields of study have since become influential in the service research literature. Like NSD, they aim to create services by defining suitable processes, methods, and tools. Both SD (Patricio et al., 2017) and SE (Böhmann et al., 2014) are being promoted as facilitators of SI.

However, little exchange occurs between these two research fields, which operate primarily in silos (Kurtmollaiev & Pedersen, 2020). There is also considerable ambiguity in the terminology and the relationships between SD, SE, and SI (Patricio et al., 2017; Antons & Breidbach, 2017; Gustafsson et al., 2020; Kurtmollaiev & Pedersen, 2020). These issues have a negative impact on service innovation research, preventing discussion and cross-fertilization between the SD and SE communities for SI research (Kurtmollaiev & Pedersen 2020).

Echoing the views of Hirschheim (2008), this study promotes the idea that increasing understanding between the different research communities would benefit SI research. Therefore, it seeks to conceptually integrate SD and SE to facilitate SI and analyze the potential benefits for SI of doing so. Thus, the study aims to answer the following research questions:

1. How can SD and SE be conceptually integrated?
2. How would integrating SD and SE facilitate SI?

Existing literature has highlighted several differences in how SD and SE facilitate SI. This study seeks to overcome these differences to increase collaboration between the research domains by using service-dominant (S-D) logic as a method theory (Lukka & Vinnari, 2014; Jaakkola, 2020) or, in other terms, a meta-level conceptual system for integrating the domain theories of SD and SE at a conceptual level. It also predicts potential ways that this integration could facilitate SI. S-D logic was chosen as the method theory for the study because it has by now

URI: https://hdl.handle.net/10125/106575
978-0-9981331-7-1

been widely adopted, and considerable efforts have been made to integrate it with both the SE (Böhmann et al., 2014; Beverungen et al., 2018) and the SD (Joly et al., 2019) research domains. Additionally, as a high-level conceptualization, S-D logic is seen as a good fit for seeking integration between the related domains.

S-D logic, which has its background in marketing science, has been causing a paradigm shift in service research from 2004 onwards, whereby difference is no longer being made between physical goods and services. Instead, value is seen as a key concept for service (Vargo & Lusch, 2004; Vargo & Lusch, 2008). Value is contextually (Vargo, 2009; Brodie et al., 2019, Alexander et al., 2018) co-created upon use (Vargo & Lusch, 2004; Vargo & Lusch, 2008). It is defined as the increased wellbeing of the service system (Vargo et al., 2008), also called the actor-to-actor network (Lusch & Nambisan, 2015).

Service in S-D logic is defined as the process of applying specialized competencies, such as knowledge and skills, for the benefit of another actor or the actor itself (Vargo & Lusch, 2004; Vargo & Lusch, 2008; Lusch & Nambisan, 2015). When suitably recombined, these competencies are seen as resources that can be used by service systems (Vargo et al., 2008) to generate value. Resources are categorized as operant and operand resources, of which operant resources act on other resources and operand resources are acted upon (Vargo & Lusch, 2004; Vargo & Lusch, 2008). Information, or knowledge, is seen as an operant resource, along with knowledge and skills, and as a key to value creation (Vargo & Lusch, 2004; Vargo & Lusch, 2008).

Madhavaram and Hunt (2008) categorize operant resources into three levels: basic operant resources (BORs), composite operant resources (CORs), and interconnected operant resources (IORs). Of these, BORs refer to the lowest level of knowledge and skills, such as the skills of an individual employee, and CORs refer to a combination of BORs. IORs are defined as a "combination of two or more distinct, basic resources in which the lower order resources significantly interact, thereby reinforcing each other" (p. 70).

Innovation in S-D logic takes place through resource integration. Resources are endlessly recombined to create new resources, which can, in turn, be recombined with other resources to create further innovations (Lusch & Nambisan, 2015). This recombination occurs in unique exchange relationships between collaborative networks (Vargo, 2009) and at different levels of context (Alexander et al., 2018; Chandler & Vargo, 2011). An actor in a value-creation network can serve according to the multiple unique contexts in which it operates (Chandler & Vargo, 2011). Brodie et al. (2019) describe these interactions as "layered interrelated networks" (p. 6).

This study uses S-D logic as a theoretical lens for integrating SD and SE. Based on the definition of operant resources (Vargo & Lusch, 2004; Vargo & Lusch, 2008; Lusch & Nambisan, 2015) and the levels of operant resources (Madhavaram & Hunt, 2008), SD and SE are first framed as IORs for SI. This framing integrates SD and SE conceptually through S-D logic. Next, the premises of S-D logic are utilized to theorize the benefits that integrating SD and SE can offer for SI. The definition of innovation as resource reintegration is applied to suggest how integrating SD and SE could facilitate SI. S-D logic implies that integrating SD and SE by recombining them could facilitate SI by creating novel resources beneficial to some actors in each context.

Section 2 of the paper discusses the background of SI, SD, and SE, how SD and SE have been reported to facilitate SI, and the characteristics of each domain. Section 3 explains the theory adaptation approach, which is used to achieve integration between SD and SE, using S-D logic as a method theory. Section 4 applies the method theory to integrate SD and SE through the lens of S-D logic to answer the research questions. Section 5 discusses the results and proposes a future research agenda. Finally, Section 6 addresses the conclusions and limitations of the study.

2. Background

Understanding the theoretical and practical background of SD, SE, and SI is necessary to appreciate their differences in worldviews and traditions. The three differ in their originating fields of research (see Figure 1) and, in the case of SD and SE, in views on how they are seen to facilitate SI.

2.1. Service innovation

SI is a heterogenous and multifaceted area of study (Antons & Breidbach, 2017; Gustafsson et al., 2020; Miles, 2008; de Grandbois, 2014), with roots in economics (Gopalakrishnan & Damanpour, 1996), healthcare, social sciences, business and management, marketing, engineering, (Patricio et al., 2017) and information systems (Antons & Breidbach, 2017) research.

The concept of SI is considerably ambiguous (Gustafsson et al., 2020; Antons & Breidbach, 2017; Witell et al., 2016), and the research field is fragmented, mainly due to the different background disciplines represented by the researchers, such as technological and marketing backgrounds (Vargo et al., 2015; Kurtmollaiev & Pedersen, 2020).

Comparing different research domains within SI research is also often difficult due to lexical cross-contamination, whereby one uses terminology from another domain without sufficiently translating the meaning (Kurtmollaiev & Pedersen, 2020). All this makes it difficult to form a unified picture of SI as a research field.

Several definitions of SI have been proposed, some of which emphasize innovation as a process (Lusch & Nambisan, 2015), while others point out the necessity of outcomes (Gustafsson et al., 2020). Kurtmollaiev and Pedersen (2020) define SI as “a new service or the creation and implementation of a new service” (p. 630) to encompass this diversity to create a generic definition.

SD, SE, and SD-logic have taken different perspectives toward SI. Witell et al. (2016) described three perspectives on SI: *assimilation*, *demarcation*, and *synthesis.* The assimilation perspective utilizes previously used theories and instruments for product innovation research. The demarcation perspective regards those approaches as unsuitable because services differ fundamentally from products. The synthesis perspective disagrees with both views and calls for approaches that can explain theories in both the service and manufacturing sectors. SD and SE have roots in the assimilation perspective, with a gradual shift toward the demarcation perspective, while S-D logic is firmly based on the synthesis perspective.

Additionally, various paradigms have directed SI research over time. Helkkula et al. (2018) have addressed these by proposing a typology of four SI archetypes present in the literature, consisting of output-based, process-based, experiential, and systemic archetypes. Of these four archetypes, the last two are closely connected to S-D logic, which will be used in this study as a method theory, and its evolutionary phases.

The *output-based* archetype concentrates on firms creating new service offerings for customers, who are seen as recipients of those outputs. Value is created in this exchange. This archetype derives its approach from product innovation management. The *process-based* archetype emphasizes the SI process and the application of new ideas in different ways, with its background in NSD and operation management. Value is interpreted as being created upon use. The *experiential* archetype is phenomenologically based and raises an actor’s experience as a value-determining factor, attributing value to its social co-creation. The *systemic* archetype sees service as taking place in ecosystems through resource integration and views value creation as a contextual action that improves the system’s wellbeing. This archetype was born out of social and living system thinking.

An example of the experiential archetype is the early definition of S-D logic (Vargo & Lusch, 2004; Vargo & Lusch, 2008), which then evolved in more contextual (Vargo 2009) and systemic (Vargo et al., 2015) directions.

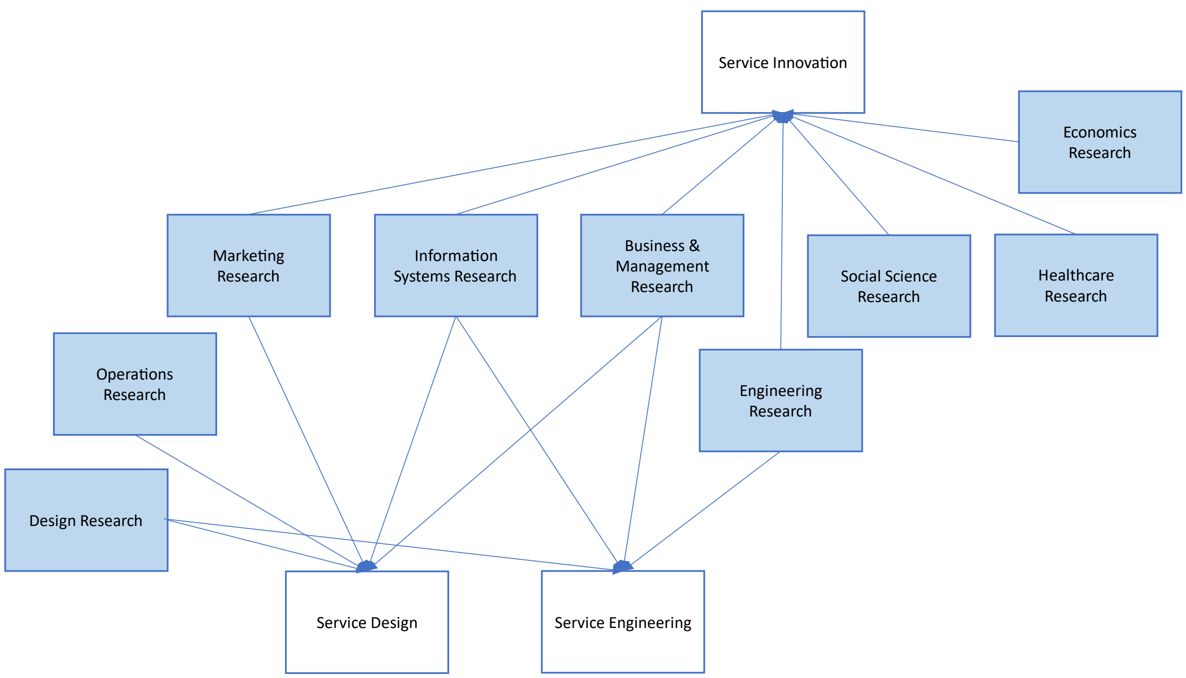

Figure 1. Background research disciplines of SI, SD, and SE.

2.2. Service design

SD originates from design research and has been influenced by operations, marketing, information systems (Joly et al., 2019; Patricio et al., 2017; Antons & Breidbach, 2017), and business and management (Patricio et al., 2017; Antons & Breidbach, 2017) research, as illustrated in Figure 1. It addresses service development from a human-centered point of view and often emphasizes customer experience and the various roles different actors play in the service design process (Patricio et al, 2019; Joly et al., 2019). SD aims to create methods and tools for service development and sees design as social innovation for solving problems (Joly et al., 2019). Apart from creating a detailed methodology, SD is increasingly being presented as a holistic approach to service development, which can profoundly influence organizations and their cultures (Kurtmollaiev et al., 2018; Joly et al., 2019; Patricio et al., 2019).

SD has been reported to facilitate SI at different levels of service ecosystems (Joly et al., 2019). Its methods derive from a design thinking process, which can influence the organizational culture (Kurtmollaiev et al., 2018) by promoting a better understanding of customers and context and envisioning and prototyping future service solutions (Kurtmollaiev et al., 2018; Patricio et al., 2017). It aims to design service settings that create unique experiences (Kurtmollaiev & Pedersen, 2020; Patrício et al., 2008; Stuart & Tax, 2004) and is seen as an approach to bringing service ideas to life together with customers (Patrício et al., 2017; Joly et al., 2019), resulting in a better quality of service as perceived by customers, and enhancing overall customer satisfaction through taking the customers' perspective (Andreassen et al., 2015). SD creates models, processes, and frameworks focused on collaboration. For example, Lievens and Blažević (2021) created a stakeholder engagement journey method to support B2B innovation, Bellos and Kavadias (2020) introduced a process framework for designing holistic customer experiences, and Lin and Chen (2014) published a model for evaluating service performance according to users' experience.

Those SD methods involving close collaboration and exchange have been seen to influence organizational culture (Kurtmollaiev et al., 2018), giving SD a strategic context. Ostrom et al. (2010) place SD in the "intersection of service strategy, service innovation, and service implementation" (p.17). The design principles SD provides for involving multiple actors in the design process (Patrício et al., 2017) discuss logical-level concepts of methods, processes, and interactions, such as customer involvement, prototyping, and multidisciplinary design teams (Ostrom et al., 2015; Lee et al., 2020).

2.3. Service engineering

SE builds on engineering and has a background in information systems and business research (Aurich et al., 2010), as shown in Figure 1. It is predominantly a technical discipline that aims to systematize service development as well as its models, methods, and tools (Bullinger et al., 2003) and the management of the development process (Aurich et al., 2010). SE often involves design research (Böhmann et al., 2014) and includes the development of services at the software level (see Margaria & Steffen, 2006). Bullinger et al. (2003) describe SE as a technical–methodological discipline. Kurtmollaiev and Pedersen (2020) situate it among research disciplines from a specific industry affiliation, noting its origins in product development. SE is often used in product-service systems (PSSs), where physical and immaterial service products are developed together (Arioli et al., 2022; Berkovich et al., 2011). While SE increasingly takes a service system-level view (Beverungen et al., 2018; Böhmann et al., 2014; Böhmann et al., 2018), it remains firmly rooted in its technological origins.

SE facilitates SI through its various engineering methods. It adopts product engineering and design techniques and seeks efficiency, effectiveness, and reliability (Kurtmollaiev & Pedersen, 2020). SE is focused on engineering new delivery processes (Kurtmollaiev & Pedersen, 2020) and creating tools and frameworks to support SI, such as the IT-driven framework for SI by Dominguez-Pery et al. (2013) and the design framework for PSSs by Watanabe et al. (2020). The engineered solutions achieve operational efficiencies and are usually related to back-office processes (Kurtmollaiev & Pedersen, 2020). While service systems are seen to consist of technology and people (Böhmann et al., 2018), the focus of SE is predominantly on process and technology-driven innovation. Although some expansion toward a socio-technical view is taking place (Böhmann et al., 2014; Böhmann et al., 2018; Beverungen et al., 2018), SE appears to situate itself technically rather than strategically toward service systems. While customers are often involved in input as providers of requirements (Immonen et al., 2016), it is the engineered solution that is seen to facilitate innovation.

SE focuses on the acts performed by the service firm (Kurtmollaiev & Pedersen, 2020), presenting logical methods and models (Aurich et al., 2010; Bullinger et al., 2003). However, in addition to this, it also envisions and creates tools (Aurich et al., 2010;

Bullinger et al., 2003) that may be described and implemented as technical artifacts (Beverungen et al., 2018). These artifacts can reach a program code level of information detail.

3. Theory adaptation approach

Jaakkola (2020) discusses the theory adaptation approach as a research design for conceptual papers. The purpose of theory adaptation is to revise extant knowledge by introducing a new perspective through alternative frames of reference, which can be achieved by informing existing theories with other theories (Jaakkola, 2020; MacInnis, 2011). In this paper, S-D logic offers a new perspective on SD and SE through the theory adaptation approach.

Following Lukka and Vinnari's (2014) definition, S-D logic in this paper is used as a method theory, and SD and SE are used as domain theories for the theory adaptation approach. A method theory is defined as a "meta-level conceptual system for studying the substantive issue(s) of the domain theory at hand" (p. 1309), and a domain theory is a "particular set of knowledge on a substantive topic area situated in a field or domain" (p. 1309). These definitions apply equally well to the chosen method theory and the domain theories presented in this paper because SD represents the collaboratively oriented design knowledge for SI. In contrast, SE represents the engineering-oriented knowledge for SI, and S-D logic takes a conceptually higher-level view of SI compared to the two domain theories.

The theory adaptation approach was chosen because, although both SD and SE are seen to facilitate SI, these research areas have diverged from each other, and cross-fertilization between them is complex, which suggests a need for conceptual integration. S-D logic was chosen as the method theory because it explains SI, which is seen as the goal of both SD and SE, it has been widely accepted in SI research, and it is gaining acceptance in both SD and SE research communities. S-D logic is well suited for use as a meta-level conceptual system since it describes SI as a universal phenomenon at a high level of abstraction.

The purpose of theory adaptation in this study is to integrate the domain theories by utilizing the method theory. MacInnis (2011) calls this type of conceptual goal a relating, or more specifically an integrating, approach and regards it as a particularly useful choice when novel insights are to be found by accommodating existing knowledge. The contribution of this exercise takes the form of an integrative framework. The integration achieves a common conceptual ground between SD and SE, facilitating discussion and cross-fertilization between the domain theories.

Currently, both domain theories refer to S-D logic, but their exact positions with regard to S-D logic are still ambiguous. There have been attempts to consider SD (Joly et al., 2019) and SE (Beverungen et al., 2018; Böhmann et al., 2014) in relation to SI from the point of view of S-D logic, but the roles that SD and SE take in SI in S-D logic have not been exhaustively explained from the point of view of S-D logic. This study attempts to remove this ambiguity by firmly integrating SD and SE into S-D logic from a theoretical perspective. Furthermore, the study conceptualizes how SD and SE facilitate innovation based on S-D logic. It also allows for further theorization about facilitating innovation by integrating the two disciplines by following the basic premises of S-D logic.

In the next section, S-D logic is applied as method theory for the two domain theories of SD and SE, and the resulting integrative framework is introduced.

4. Integrating SD and SE as resources for SI through S-D Logic

Proceeding to integrate SD and SE through the method theory of S-D logic, the two domain theories are first analyzed based on the basic premises of the method theory. Next, the implications of this framing for how SI should be understood in SD and SE, based on S-D logic, are discussed. Finally, an S-D logic-based integrative framework for SD and SE is introduced, and its potential implications for SI are discussed.

S-D logic identifies resources and actor-to-actor networks as basic foundations of service, and SI is defined as resource recombination (Vargo & Lusch, 2004; Vargo & Lusch, 2008; Lusch & Nambisan, 2015). Resources are classified into operant and operand resources, where information, knowledge, and skills are operant resources, which act upon other resources, such as raw materials (Vargo & Lusch, 2004; Vargo & Lusch, 2008). Based on the earlier adaptation approach, SD and SE can be inspected through this meta-theoretical lens of S-D logic.

The SD discipline encompasses a multitude of design knowledge and skills, along with design-related information. Equally, SE is built on engineering knowledge, skills, and related technical information. Taking the perspective of S-D logic, it becomes evident that these features of SD and SE would be considered operant resources in S-D logic. Following the levels of resource categorization by Madhavaram and Hunt (2008), on the individual level, these resources fall into the BOR category, and when combined, they form CORs. Further, based on the notion that these basic resources of interaction, knowledge, and skills interact significantly inside each of the disciplines and reinforce each other, SD and SE can themselves be considered to be IORs.

Having framed SD and SE as IORs in S-D logic, SI in these research domains can also be discussed through the S-D logic perspective. Innovation in S-D logic is resource recombination (Vargo & Lusch, 2004; Vargo & Lusch, 2008; Lusch & Nambisan, 2015). SD and SE currently attribute facilitating innovation to the processes of their respective disciplines, methods, and tools (Joly et al., 2019; Kurtmollaiev & Pedersen, 2020; Böhmann et al., 2018). Through the S-D logic lens, SD and SE resources are recombined in the respective actor-to-actor networks of SD and SE to achieve innovation. This recombination occurs at the three resource levels of BOR, COR, and IOR of each discipline.

Seeing SD and SE as IORs that recombine their resources on all three levels makes it evident, in the light of S-D logic, how the disintegration of these disciplines derives from limiting the resource recombination within the boundaries of each research domain. The available resources for facilitating SI in SD and SE are different. SD recombines design knowledge, skills, and information for SI, while SE recombines engineering knowledge, skills, and information for SI. Recombining different resources is a central mechanism for facilitating innovation in S-D logic. On this basis, extending the resource recombination over the boundaries of SD and SE and creating an interchange between the two domains can provide novel opportunities for SI. This extended scope of resource recombination could occur at all of the three resource levels: BOR, COR, and IOR.

Figure 2 illustrates the proposed integration by presenting a framework for recombining resources from both disciplines. Individual BORs are represented as single graphical items (a circle for SD and a triangle for SE), and CORs are defined as their combinations. IORs encompass those lower levels and represent the domains of SD and SE. Arrows describe the recombination of resources on all three levels. On the BOR level, an individual could utilize knowledge, information, or skills from both resource pools, such as combining design skills with engineering principles. On the COR level, different individuals' knowledge and skills, and information from both disciplines, could form novel combinations, for example, a service engineer could work together with a designer. At the highest level, IOR, recombining both resource pools could lead to an entirely new discipline, which draws from a greater variety of information, knowledge, and skills and recombines these in novel ways, which increases the number of possible recombinations for innovation. At this level, SD and SE methods, skills, and knowledge would be mixed and utilized together for SI.

SI-related value creation resulting from resource recombination occurs in a context whereby service provides value to one or more actors (Vargo, 2009; Chandler & Vargo, 2011). For example, SD contexts may currently involve collaboration with the customer, and SE may operate in contexts relating to internal back-office operations. The contexts of the proposed novel recombinations of SD and SE resources may be associated with the current contexts of SD and SE or may be entirely novel, opening new areas of possibility for SI through the integration of SD and SE.

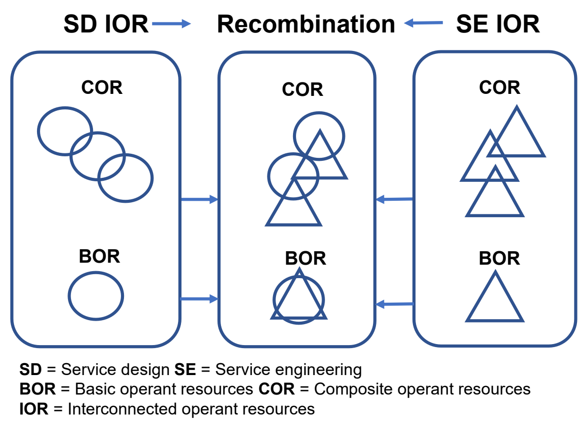

Figure 2. The integrative framework: recombining SD and SE resources.

5. Discussion and future research agenda

The fragmented research field in SI has been seen as problematic and preventing cross-fertilization between different research domains that seek to facilitate SI, such as SD and SE (Kurtmollaiev & Pedersen, 2020). Further, calls have been made to achieve a theory-based understanding of SI (Gustafsson et al., 2020) to replace the numerous individual approaches from different research domains. This study attempted to address this issue by integrating SD and SE theoretically at a conceptual level. The two research domains were inspected through the lens of S-D logic, using the adaptation approach (Jaakkola, 2020) for integration. This integration was achieved by framing SD and SE as domain theories and using S-D logic as method theory, which was then used as a meta-theoretical lens for integrating the domain theories. This framing revealed that SD and SE could be seen as IORs for SI.

The premises of S-D logic further suggest that recombining SD and SE as resources for SI could lead to novel innovations (Vargo & Lusch, 2004; Vargo & Lusch, 2008; Lusch & Nambisan, 2015). These recombinations are proposed to occur at all of the three resource levels within SD and SE (Madhavaram & Hunt, 2008). As the potential pool of resources to recombine grows, the number of possible new combinations also increases. According to S-D logic, since innovation takes place through resource recombination, allowing novel combinations of resources that include the scope of both SD and SE could further facilitate SI.

The current literature on SD and SE is siloed and attempts to conduct cross-disciplinary research are rare (Kurtmollaiev & Pedersen, 2020). This study differs from most extant literature by attempting to synthesize these research fields by integrating them through a method theory to enable exchange between the two research domains. This allows SD and SE to share a common worldview and vocabulary, reducing the cognitive distance between them. Further, when the current SD or SE literature refers to S-D logic, it does not discuss the role of SD and SE in the S-D logic framework, which this study does by framing SD and SE as resources for SI. Although there have been previous attempts (Ordanini & Parasuraman, 2011) to frame different actors, such as employees, customers, and business partners, as resources from the S-D logic point of view, this study differs from those in its approach, which treats the knowledge, methods, and skills from individual research domains as multi-level resources and separates actors and resources from each other. Therefore, this study adds to the current literature by taking a new perspective on SD and SE and clarifying their roles in relation to S-D logic, strengthening the theoretical backgrounds of SD and SE. This perspective is then extended by proposing resource recombination between the research domains for facilitating SI.

Possibilities for resource recombination on three levels between SD and SE are proposed as a new resource integration framework, which adds to the SD, SE, and SI bodies of literature and opens up new research directions for facilitating SI. According to Lusch and Nambisan (2015), resource recombination becomes increasingly difficult at higher resource levels, which is more likely to lead to a competitive advantage for companies. Future research could utilize this framework for creating innovation settings that pull from both disciplines at all three levels.

This conceptual study opens up several new research questions, summarized in Table 1. The main identified research questions include:

- In what context(s) could the newly recombined resources from SD and SE create value?
- Which resources from SD and SE would likely create value if recombined?
- How could the recombination of resources from SD and SE be achieved in practice?

The proposed sub-questions are examples of potential directions for further research in relation to the main questions.

Empirical research is required to confirm the suggested benefits of this interdisciplinary resource recombination. Further research could investigate potential contexts and actors that could experience value from resource recombination from SD and SE. These contexts may exist inside or outside the developer organization. For example, Ordanini and Parasuraman (2011) found evidence of employee collaboration impacting both innovation volume and radicalness. In the context of SD and SE, could back-office processes benefit from design knowledge? Could customer-focused SD projects benefit from engineering skills?

Identifying particular skills, tools, or knowledge that could benefit each context also requires further research. For example, could the engineering approach strengthen prototyping in SD? Could customer-centric methods facilitate innovations in engineering? Possible ways to achieve this resource integration in practice should also be addressed. For example, would involving specialist individuals from both disciplines in projects to combine their knowledge and skills facilitate innovation in organizations? Could better communication between interdisciplinary teams lead to novel SIs? What role does organizational structure play in recombining SD and SE resources?

This study suggests that resource recombination between SD and SE can occur at different resource levels. Further research is needed to understand how recombinations at these different levels can be achieved, and their roles in facilitating SI need to be understood. Gustafsson et al. (2020) also called for research on the relative importance of different factors in facilitating SI, and studying resource recombinations between research domains at different levels could offer a frame of reference for such work. Additionally, potential barriers and disadvantages that recombining resources could pose at different levels would require further research.

In practice, we envision that integration could be achieved by practitioners of one area sharing knowledge with practitioners of the other one at the BOR level and by increasing collaboration between teams of practitioners at the COR level. This could lead to practices pulling from both pools of knowledge at the IOR level. Research could investigate theory and methods to advance service innovation pulling from both domains. We expect that combined knowledge from SD and SE would produce new concepts and methods in addition to the existing ones.

Future empirical research could focus on experimental settings to pilot novel resource combinations and analyze what companies currently do. It is possible that, despite the fragmented state of the literature, practitioners are already successfully combining SD and SE approaches in organizations to create novel innovations. Digital media companies employing back-end and front-end developers, graphic designers, and analysts could work as an example of a current cross-disciplinary approach for further studies. More information is needed about the benefits and issues encountered in practice for this type of resource integration and its role in facilitating SI in these companies.

Table 1. Future research agenda.

Main research question	**Sub questions**
In what context(s) could the newly recombined resources from SD and SE create value?	• Can design knowledge benefit back-office processes? • Can engineering skills benefit customer-focused SD projects? • What role do resource recombinations at different levels play in facilitating SI?
Which resources from SD and SE would likely create value if recombined?	• Can the engineering approach strengthen prototyping in SD? • Can customer-centric methods facilitate innovations in engineering?
How could the recombination of resources from SD and SE be achieved in practice?	• Can organizations facilitate innovation by involving specialist individuals with SD and SE backgrounds in projects? • Does improving communication between interdisciplinary teams facilitate innovation in organizations? • What role does organizational structure play in recombining SD and SE resources? • How can resource recombinations at different levels be achieved? • What barriers exist to recombining resources at different levels? • What disadvantages are there from recombining resources at different levels?

6. Conclusions and limitations

This study contributes to both theory and practice. Gorley and Gioia (2011) called for prescience from theoretical contributions, encouraging researchers to enlighten academics and reflective practitioners. Theoretically, the benefits that this study suggests for SI from recombining SD and SE resources can be treated as an empirically verifiable hypothesis for future studies. This creates several interesting questions and presents an opportunity for advancing SI. Conceptually integrating SD and SE through S-D logic is a new approach to these research domains. It contributes to the SI research literature by providing a common meta-theoretical ground for the SD and SE research domains and enabling exchange and cross-fertilization between them.

The study also contributes to the SD and SE literature by framing these disciplines' positions regarding their role in S-D logic, strengthening the theoretical background for further studies, and facilitating research approaches that pull from S-D logic in both SD and SE.

Further, the presented new framework contributes to the SI, SD, and SE literature by conceptualizing potential opportunities for novel resource recombinations and allows future researchers to create research settings and analyze the results against a common frame of reference by suggesting resource recombination between the disciplines at three resource levels. The framework adds to previous research on resource-level conceptualizations by framing two research domains as multi-level resources and proposing resource recombinations between them at various levels of integration.

This study also contributes to practice by suggesting a potential approach for facilitating SI in organizations. Combining knowledge, tools, and skills from the design and engineering domains can facilitate innovation, creating opportunities for companies and other organizations to create value and improve their competitive advantage. Further, the presented three-level resource integration framework can be used as a thinking aid and a tool for planning potential efforts for interdisciplinary resource integration in organizations.

Despite its contributions, this study also has some limitations. Firstly, while the existing literature on SD and SE was discussed, no systematic literature review was conducted, which leaves room for omissions regarding the scope of the relevant literature. A more systematic approach could highlight new information about how SD and SE currently facilitate SI, and their differences, and allow for more detailed suggestions about potential ways to recombine resources between these disciplines. Additionally, the basis of this study is conceptual. Currently, its proposal about the potential benefits for SI that could be achieved through integrating SD and SE resources lacks empirical evidence. Therefore, its contributions should be taken as a prompt for further empirical studies.

6. References

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