Reconceptualizing Platforms in Information Systems Research through the Lens of Service-Dominant Logic

Abstract

Platforms have gained significant attention in the field of information systems (IS) research. However, the concept of platforms remains fluid and complex due to the diverse phenomena associated with it. Research to date tends to cluster around two predominant perspectives: the economic network perspective and the architectural design perspective. To reconcile the divergent perspectives of platforms and establish a more cohesive foundation for IS theorizing, we undertake an interpretive literature review through the lens of service-dominant (S-D) logic. Drawing on an extensive analysis of the literature, we develop an S-D Platform Framework that provides a deep understanding of the multifaceted nature of platforms as a vital IS capability for value co-creation. This framework sheds light on the fundamental facets of relationality, ambidexterity, and cooperativity, which explain the deep structure of platforms in the realm of IS research. Building on our proposed framework, we put forth an agenda that aims to guide future studies towards a more theoretically compelling trajectory.

Keywords: Platform, two-sided network, modular architecture, service dominant logic, conceptualization, literature review

1. Introduction

The platform-mediated economy had reached USD 4.3 trillion in 2016 (Evans and Gawer, 2016) and could increase to USD 60 trillion in 2025 by some estimations (McKinsey, 2018). Platforms such as Alibaba.com, Uber, iOS, and Oracle solutions have disrupted many business landscapes by means including online transactions, resource sharing, app development, and enterprise resource planning (Eaton et al., 2015; Lee et al., 2018; Sun et al., 2021; Tan et al., 2015). Although we admire the success of these striking business cases, we ask: what is the commonality among these platforms? Answering this question is important because strategizing around a platform of distinctive capabilities has become a key success criterion for modern organizations (Ross et al., 2017; Ross et al. 2019). However, leveraging platforms to transform business is challenging for firms operating with traditional value-

chain-driven business models due to firms' lack of experience and a vague understanding of platforms (Subramaniam, 2021).

Against this backdrop, not surprisingly, platforms have emerged as an important topic in information systems (IS) research (de Reuver et al., 2018; Hein et al., 2020; Tiwana et al., 2010). With platforms' potential for disruption, the IS literature has examined platforms' transformational effects on a variety of phenomena, such as sales performances (Ceccagnoli et al., 2012), purchasing behaviors (Huang et al., 2017), network effects (Song et al., 2018), governance practices (Huber et al., 2017), and system design (Spagnoletti et al., 2015). While platforms are *omnipresent* with a large variation of functions and types in the IS literature (de Reuver et al., 2018), the challenge becomes "*if an identity is everywhere, it is nowhere*" (Brubaker & Cooper, 2000, p. 1). If the important concept of platforms is so fluid, how can it be adequately accounted for in IS theorizing?

Although the IS literature has extended knowledge about platforms considerably across different contexts, conceptualizations of their deep structure vary widely and tend to rely on theorizing that predates modern technology-based platforms. At least two prominent views can be discerned. In the economic network view, a platform is seen as a network that "exhibits two-sidedness in that they [platforms] facilitate matching and transactions between consumers and service providers" (Zhu et al., 2021, p. 1009). In the architectural design view, a platform is seen as an "extensible codebase of a software system that provides core functionality shared by modules that interoperate… [through] interfaces" (Tiwana et al., 2010, p. 676). Accordingly, the IS literature has launched research investigations from both economic network and architectural design perspectives. The economic two-sidedness stream, for example, focuses on examining how to coordinate relationships between actors on different sides of a platform to boost network effects (Parker et al., 2017; Song et al., 2018; Thies et al., 2018), whereas the architectural design stream[1], for example, focuses on exploring how to navigate the tension between openness and control to embrace generativity (Benlian et al., 2015; Huber et al., 2017; Sun et al., 2021). Both streams typically follow implicit theoretical views – network externalities

[1] This stream includes not only design science research (Spagnoletti et al., 2015), but also studies of system architecture (Sun et al., 2021) and governance mechanisms (Huber et al., 2017), which have strong implications for platform design in general.

for the IS economics stream and system modularity for the IS design stream. However, the differences and ambiguity in conceptualization can inhibit platform theorizing as a whole due to the "absence of a shared understanding of topics among its different subcommunities" (Sarker et al., 2019, p. 696). How can one explain the complexity of platform-enabled network externalities and modularity within a single view? In general, the IS literature on platforms has offered vivid and important insights but has not, as yet, systematically or formally articulated a theoretical foundation to address the "inherent complexity of digital platform dynamics" (de Reuver et al., 2018, p. 132). The absence of a clear and well-articulated conceptualization of a phenomenon leads to a lack of clarity, posing challenges for researchers and practitioners in comprehending and using the various facets of the concept related to the phenomena in a productive manner (Dubin, 1978).

Hence, our overall objective is to offer insights into the concept of platforms in IS research. We have three specific aims: (1) to provide an overarching theoretical framework for the deep structure of platforms; (2) to understand different facets of platforms and how they are constructed; and (3) to suggest avenues for further research. We draw inspiration from the literature that (re)conceptualizes complex phenomena in IS theorizing to design our study, such as Xia and Lee's (2005) work on IS project complexity, Burton-Jones and Straub's (2006) work on effective system use, and Avital and Te'Eni's (2009)'s work on generativity. To accomplish our aims, we conducted a literature review on platforms in IS research. The review took place around the underlying perspective of service-dominant (S-D) logic (Vargo and Lusch, 2008, 2004). *S-D logic* encompasses the idea of actors linked in a network (e.g., providers and beneficiaries) and the idea of the resources (e.g., technology artifacts) that are involved (Lusch and Nambisan, 2015). Thus, S-D logic allows us to establish an elemental boundary condition for platforms as an *IS capability* that allows heterogeneous actors to co-create value by exchanging operant resources (e.g., specialized knowledge and skills) (Lusch and Nambisan, 2015; Vargo and Lusch, 2008). For example, Amazon.com, an e-commerce platform (a classic example of a two-sided market) facilitates value co-creation between buyers and sellers by coordinating information of demand-and-supply. Similarly, iOS, a mobile operating platform (a classic example of a modular

architecture) facilitates value co-creation between independent developers, end users, and system operators by synchronizing knowledge and skills of software development.

Our study makes several important contributions. By reconceptualizing platforms, we establish a key theoretical boundary condition – an IS capability for value co-creation – that enables researchers to delineate platform-related phenomena and study them in a more theory-driven manner. Our reconceptualization departs from the views that consider platforms as primarily a matter of two-sidedness or modularity. Extending these views, we provide novel insights by considering the key variations in both human capital endowments of operations and the technology artefacts with which they operate. These variations play a crucial role in influencing the strategic decision-making associated with platforms, aligning with the axioms of S-D logic. Our theorizing posits that the coexistence and coevolution of capability facets of relationality, ambidexterity, and cooperativity define and explain the uniqueness of platforms in IS research. By doing so, we set the stage for future studies on platforms and their variation in venturing across social and material aspects. Building on our reconceptualization and theorizing of platforms in IS research, we develop a research agenda and present several research priorities structured around five avenues for future studies.

2. Theoretical Foundation: Service-Dominant Logic

To reconceptualize platforms, we examine the IS literature through a S-D logic lens (Vargo and Lusch, 2016, 2008, 2004). We use S-D logic as the theoretical lens because its foundational axioms — "service is the fundamental basis of exchange" and "value is co-created by multiple actors" (Vargo and Lusch, 2016, p. 8) — have the potential for an overarching framework that encompasses previously siloed perspectives. For example, although platforms are used to describe diverse systems, the core purpose of platforms is to support value co-creation through service, such as the service of supply-and-demand on an e-commerce platform (Tan et al., 2015), the service of computing power on a mobile operating platform (Eaton et al., 2015), and the service of business process integration on an enterprise platform (Huber et al., 2017). Because our reconceptualization of platforms draws on S-D logic extensively, we describe its axioms, conceptual foundations, and implication for IS research in detail.

In their seminal work, Vargo and Lusch (2004, p. 2) proposed S-D logic and argued that *service*— "the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself"— captures the essence of all economic exchange (A1)[2]. Differing from the product-dominant logic that sees services (plural) as a *unit of output*, S-D logic understands service (singular) as a *process*. Specifically, in a S-D logic vein, value is not created by the production of surplus tangible goods but *co-created* by resource exchange between one actor (e.g., provider) and another (e.g., beneficiary) (A2) (Vargo and Lusch, 2008)[3]. Value creation is only possible when a good is consumed or used by actors, and thereby actors are resource integrators (A3) (Vargo and Lusch, 2008). Because actors are heterogeneous, value is always uniquely and phenomenologically determined by the situational requirements (A4) (Vargo and Lusch, 2008). To better accommodate value from heterogeneous actors, value co-creation should be coordinated through actor-generated institutions and institutional arrangements (A5) (Vargo and Lusch, 2016).

To further characterize S-D logic as an emergent school of thought, the literature has developed and refined a S-D lexicon with eight conceptual foundations (CF) (Lusch et al., 2008; Lusch and Vargo, 2006; Vargo and Lusch, 2016). S-D logic implies that the exchange of *operant resources* (CF1) (e.g., knowledge, skills, capabilities, and competencies) forms the basis for value creation. Value creation is associated with *resourcing* (CF2) (i.e., the activity that turns operant resources into a specific benefit) and focuses on *service and experiencing* (CF3) (i.e., the interaction between actors). Value is not delivered by transferring ownership of a product (e.g., from a producer to a user) but co-created by the process of doing (e.g., using a product). In this case, *value proposing* (CF4) (i.e., a scheme of how to facilitate value co-creation) outperforms value delivery. Because actors are value co-creators and sources of operant resources, a *dialog* (CF5) founded on adaptation to each other becomes important to maintain a *value-creation network* (CF6) that coordinates resource exchange. *Learning* (CF7) from feedback (e.g., performance indicators) fuels the evolution of a value-creation network. Overall, central

[2] A stands for Axiom. We opted to use the five axioms to illustrate the underlying logic of S-D logic (give ref), as they represent a refined version of the initial 11 S-D premises developed by Vargo and Lush (2016).

[3] We acknowledge the potential lexicographic slip with the terminology (i.e., provider and beneficiary) because it may be intertwined with goods-centric language. However, as Vargo and Lusch (2008) have clarified, "suitable language [to describe the nature of S-D logic] is hard to find" and these terms are "not judged to be sufficiently critical to warrant changing in isolation" (p. 2).

to the S-D logic is *collaboration* (CF8), not a linear value chain from production to consumption, but as a general philosophy of business.

When providing stronger implications of service research for the IS literature, Lusch and Nambisan (2015) contextualized S-D logic into a high-level theoretical framework with three central themes: (1) an *actor-to-actor network* is a relationship structure that offers an organizing logic for resource exchange and value creation between multiple actors; (2) *resource distribution*[4] enhances the efficacy and effectiveness of resource exchange by facilitating access to appropriate resource bundles; and (3) *resource integration* enables value co-creation between different actors by supporting the underlying roles and processes. Extending these themes to understand technology leads to viewing technology as an active venue that enables (or inhibits) value co-creation by distributing operant resources in an actor-to-actor network. Such extension emerges in conjunction with the fundamental shift in organization and digital infrastructure portfolios – as the tight interlocking of services, technologies, and organizations has rapidly morphed into a rapid self-serviced process of constantly evolving platforms (de Reuver et al., 2018; Tilson et al., 2010). Thus, S-D logic allows us to make three assumptions: (1) a platform exists on value co-creation; (2) a platform should have three essential components: a network of actors, mechanisms for resource distribution, and mechanisms for resource integration; and (3) strong value co-creation capabilities are desired across the three components.

Fundamental to many value co-creation activities is the rapid development and widespread deployment of technology (Barrett et al., 2015). The literature has generally used the term *platforms* to describe a digital-enabled foundation on which providers and beneficiaries can realize value co-creation by coordinating networks and cultivating complementary capabilities (de Reuver et al., 2018; McIntyre and Srinivasan, 2017; Tiwana et al., 2010). The central argument is that a platform allows different actors (e.g., operators, developers, and users) to co-create value by encouraging innovation and exploiting network effects (Ceccagnoli et al., 2012; Goldbach et al., 2018; Kim et al., 2016). However, when a platform is composed of various elements – such as digital technology, complementary

[4] To enhance readability, we use resource distribution as an umbrella label to describe resource liquefaction and resource density, because as Lusch and Nambisan (2015) describe, both resource liquefaction and density aim to effectively distribute ("share" and "mobilize") resources between actors.

innovation, and network effects – the interplay can be complex in terms of how each part of the bundle contributes to the overall value of the entire platform (Tilson et al., 2010). Furthermore, understanding interdependencies between different actors can be challenging because providers and beneficiaries may belong to different industries and need not be bound by strict contractual agreement but have significant interdependence (Jacobides et al., 2018). These challenges have catalyzed recognition of the need for research focused on deepened understanding of the complexity of platforms as an important vehicle for value co-creation (Barrett et al., 2015).

Drawing on the above discussion, we expect that a pivotal aspect of reconceptualizing platforms lies in comprehending the deep structure of value co-creation by effectively materializing and mobilizing operant resources from heterogeneous actors. For example, to enhance business performance, an operator (e.g., a platform owner) needs to create and share knowledge (e.g., computing resources) with actors (e.g., third party developers) in exchange for their expertise (e.g., app development skills) and coevolve with other actors' (e.g., app users) specificity (e.g., situated requirements). Thus, S-D logic directs our attention toward the transformation of operant resources (e.g., capabilities) for value co-creation. The transformation is driven by service and manifested through the design and management of digital artefacts. Anchored in S-D logic, we aim to take a pioneering stride towards developing a coherent theory by offering a comprehensive reconceptualization of platforms. The reconceptualization allows us to portray a more thorough understanding of platforms in IS research.

3. Review Methodology

Our literature review can be broadly classified as a theoretical review (Paré et al., 2015), with a combination of organizing and broad theorizing reviews (Leidner, 2018). Our aim is to move beyond mere compilation and description of prior research to address a research gap. Instead, we endeavor to reconceptualize platforms by synthesizing the variables and effects that comprise platform-related phenomena in the IS research. Since methodological guidelines for reviews aiming at understanding and conceptualizing are relatively scant (Rowe, 2014), we followed the guiding recommendation of Schultze (2015, p. 183) to "continue theorizing throughout the review process so that researchers might achieve the higher levels of abstraction that theory development calls for". In doing so, our literature

review comprised an iterative approach as Table 1 depicts. In our quest to identify relevant literature on platforms, we made a deliberate choice to exclude databases such as Web of Science and ProQuest. This decision was based on preliminary searches conducted in these databases, which yielded a substantial number of non-IS platform papers with limited value for our objective of reconceptualizing platforms in IS research. To maintain a strict focus on IS literature, we streamlined our literature sampling process by exclusively considering the Senior Scholars' Basket Journals. We supplemented our sampling by including publications from three contender journals (i.e., *Decision Support Systems, Information & Management,* and *Information and Organization*) (Fitzgerald et al., 2019) and four IS journals with high impact factors (i.e., *Information Systems Frontiers, Information Technology & People, International Journal of Information Management,* and *Internet Research*).

Table 1

Literature Review Approach

Step 1. Literature screen	**Step 2. Article identification**	**Step 3. In-depth reading and analysis**	**Step 4. Sensemaking and theorizing**
Keyword (i.e., platform) searching Screening catalogues of the selected 15 outlets	Scanning abstracts and paragraphs containing the keywords Using frequency of search terms as an indicator of relevance 77 empirical and five conceptual papers identified	Applying analysis scheme: - Definitions - Antecedents - Design and management mechanisms - Outcomes	Synthesizing findings Implications from service-dominant logic Avenues for future research

Note: "⬅" represents iterative flows.

More specifically, we conducted searches using the keyword "platform" in search engines for the 15 selected journals to screen the literature. We did not impose any restrictions on the search period to allow a wider inclusion of literature. Next, we scanned the abstracts and the paragraphs containing the

term “platforms” (as needed) to exclude papers that merely mentioned platform within their specific references or as an expression without referring to the relevant underlying concepts (e.g., a platform for conducting neuro IS experiments). We also used the frequency of the search term’s occurrence in the paper as a criterion to gauge its relevance for our review. Accordingly, we selected papers for in-depth reading that either mentioned platforms at least three times or provide explicit definitions of platforms. Furthermore, we carefully examined the reference lists (backward search) to identify any papers that might have been inadvertently overlooked during the screening process (Webster and Waston, 2002). As a result, we identified 77 empirical papers (comprising both quantitative and qualitative studies) and five conceptual papers.

We then undertook a comprehensive examination of the 82 papers through in-depth reading, involving coding, analysis, and discussion focused on three aspects of the platform construct: definitions, antecedents, and effects. First, we sense-made and theorized the concept of platforms in the identified papers following a common practice of thematic classification (Braun and Clarke, 2017), in this case through a S-D logic lens. Specifically, to provide a common conceptual ground for diverse platform-related phenomena, we extracted and analyzed the definitions of platforms in the literature to show the current state of understanding. As an initial check on the feasibility of our approach and to motivate our subsequent work, we demonstrated that the eight conceptual foundations of S-D logic could be discerned in the definitions derived from both the economic network and architectural design perspectives. Appendix A shows our classification of the definitions. We then employed an abductive approach to thoroughly examine the literature. Specifically, we used the three central themes of S-D logic as the foundation for our literature analysis and theoretical exploration. By doing so, we were able to establish a robust theoretical boundary for our analysis. We then followed the Gioia Methodology (Gioia et al., 2012) to extract conceptual dimensions from the 77 empirical studies[5]. This approach allowed us to synthesize our observations by identifying commonalities and patterns within the data. Appendix B provides information about our coding and analysis processes for aggregating the conceptual dimensions. Finally, based on the literature review, we developed a novel conceptual

[5] We excluded the five conceptual papers to avoid duplication, as many of them used overlapping empirical studies to present their viewpoints.

framework that highlights platforms as a vital IS capability for strategic decision-making in the design and management of diverse digital technologies (such as e-commerce, social media, sharing economy, mobile systems, and enterprise systems), with the three facets of relationality, ambidexterity, and cooperativity. The literature review steps were repeated iteratively until the authors achieved a consensus on the validity and comprehensiveness of findings. Overall, our objective in conducting the literature review extends beyond providing a descriptive summary of what is known, to establish a profound understanding of how platforms can be reinterpreted and reconceptualized through a consistent theoretical lens in IS research.

4. Understanding the Platform Landscape

Our aim is to offer new insights into the important concept of platforms in IS research. Considering the complexity and dynamism of platforms in various contexts, readers may have encountered challenges in understanding how to relate platforms to service, or even in defining what a platform truly is. Thus, as a first step, we provide a comprehensive overview of the current landscape of platforms in IS research and explore how platforms can be associated with S-D logic.

4.1. Current Conceptualizations of Platforms in the IS Literature

The IS literature on platforms is heterogeneous, as it examines a variety of interrelated factors that influence platform-enabled economic exchanges (Jung et al., 2019; Lin et al., 2011; Oh et al., 2015) and complex technology architectures (Cennamo et al., 2018; Eaton et al., 2015; Nielsen and Aanestad, 2006). Table 2 illustrates that the five conceptual papers identified in our review generally follow two perspectives – economic network and architectural design – in their explanation of platforms in the IS realm. Appendix A, which presents the classification of explicit definitions of platforms in the remainder of our review sample, provides additional evidence to support our assertion. We acknowledge the existence of conceptual work in related disciplines such as innovation management (Gawer, 2014), strategic management (McIntyre and Srinivasan, 2017), and e-markets (Hein et al., 2020), which provide diverse typologies and terminologies to derive multiple theoretical perspectives on platforms. However, the IS literature demonstrates latent yet significant evidence that the discussion

of platform-related phenomena has primarily been underpinned by the economic network and architectural design perspectives.

Table 2

Current Understanding of Platforms in Conceptual Works

Perspective	Understandings from the Conceptual Works
Economic network	"Multisided platform [is] mediating different groups of users, such as buyers and sellers." (de Reuver et al., 2018, p. 127) "Digital platforms share three basic characteristics: they are technologically mediated, enable interaction between user groups and allow those user groups to carry out defined tasks." (Bonina et al., 2021, p. 3) "…platform as intermediates that facilitate transactions between multisided markets (i.e., users and complementors)" (Li and Kettinger, 2021, p. 1525)
Architectural design	"… the architecture of the generic resource layer, which describes the computers, networks, peripherals, operating systems, data base management systems, UI frameworks, system services, middleware, etc. that will be used as a platform for the construction of the system for the enterprise." (Aerts et al., 2004, p. 783) "Platform [is a] extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate." (Tiwana et al., 2010, p. 676) "Digital platform (technical view) [is] an extensible codebase to which complementary third-party modules can be added." (de Reuver et al., 2018, p. 127) "…platform as IT artifacts that facilitate innovation through platform architectural design." (Li and Kettinger, 2021, p. 1527)

First, the literature following an economic network perspective primarily focuses on the participation and transactions among diverse groups of actors, as well as the specific conditions that enable platform operators to achieve network effects (Chen et al., 2014; Leong et al., 2019; Liang et al., 2021). Echoing

the literature on two-sided markets and recognizing the enduring significance of market intermediaries (Rochet and Tirole, 2003; Rysman, 2009), Parker et al., (2017) succinctly summarized platforms as a multi-sided market. In particular, they suggested that "The two [multi]-sided literature conceives of platforms as mediating markets with *network externalities* that cross distinct user groups and shows how subsidies to one group become optimal" (Parker et al., 2017, p. 258). Drawing on the multi-sidedness paradigm, the IS literature has inquired into the multitude of factors that can explain platform actors' capitalization activities and platforms' mediating role. For example, enhancing financial and business performances is regarded as a major determinant of the decision to become a provider (e.g., sellers and app developers) for a platform (Ceccagnoli et al., 2012; Kim et al., 2016; Wright et al., 2017; Ye and Kankanhalli, 2020), whereas receiving quality service is key to attract and sustain beneficiaries (e.g., buyers and app users) (Cheng et al., 2018; Lu et al., 2021; Xu, 2021). Furthermore, the platform operator assumes a critical role in mediating interactions between actors on various sides, thereby facilitating the emergence of network effects, as indicated by pricing and access control strategies (Bakos and Katsamakas, 2008; Benlian et al., 2015; Lin et al., 2011; Thies et al., 2018). However, the literature is lacking in both theoretical development and empirical evidence regarding the material characteristics of platforms, which serve as the digital manifestation of multi-sided economic networks (Tilson et al., 2010; Yoo et al., 2012).

Second, the literature adopts an architectural design perspective and delves into the intricacies of platform development and governance, specifically addressing the unique demands of heterogeneous actors in their respective contexts (Huber et al., 2017; Spagnoletti et al., 2015; Sun et al., 2021; Tiwana, 2018). In their research commentary, Rai et al. (2019, p. iii) pointed out that "Unlike previous technologies, the layered modular architecture of digital platforms fuels *generativity*, defined as the platform's ability to foster unprompted innovation through continuous recombination of different modules". The literature has shown that a platform typically contains three architectural layers (i.e., modules): a codebase, add-ons, and an interface through which add-ons interoperate with the codebase (Spagnoletti et al., 2015; Sun et al., 2021; Tiwana et al., 2010; Yoo et al., 2012). Such design allows a complex system (i.e., platforms) to rapidly respond to and accommodate changes that are unforeseeable

by the system operator within minimum effect on other parts of the system (Johannessen et al., 2012; Yoo, 2013). To do so, a platform operator must consider a critical challenge for platform design and governance – that is, considering how to "retain sufficient control to ensure the integrity of the platform while relinquishing enough control to encourage innovation" (Tilson et al., 2010, p. 679). To tackle this challenge, studies have highlighted boundary resources as the focal unit of analysis. Boundary resources encompass software tools such as application programming interface (API) and application development kit (SDK), as well as standards that coordinate the arms' length relationship among a platform's different layers (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013; Karhu et al., 2018). However, given that the principles of multi-layer architecture and standardization have been long-established in the realm of client-server computing (Flurry and Vicknair, 2001; Kambalyal, 2010), it is worthwhile for IS research to undertake further investigation towards a higher-order conceptualization of platforms.

In summary, although the concept of platforms has been used to describe various information systems such as e-commerce sites, enterprise systems, game consoles, healthcare systems, resource sharing systems, and mobile operating systems, the literature on platforms has predominantly focused on the impact they generate, specifically in terms of network effects and generativity. This emphasis has traditionally been explored through two distinct perspectives, namely the economic network and architectural design perspectives. However, the literature has not systematically or formally articulated a theoretical integration of platforms' two-sidedness and modular architecture or explained the multiplicity of platform-related phenomena. Developing a coherent theoretical foundation for platforms is important for two reasons. One, an ambiguous conceptualization runs the risk of the platform concept becoming a "fad" (de Reuver et al., 2018), which fails to contribute to the development of "homegrown theory" specifically related to platforms in the IS discipline (Tiwana et al., 2010). And two, as investments in the "platform economy" continue to rise and the significance of "platform strategy" gains growing recognition, decision makers increasingly engage in activities that encompass both two-sidedness and modular architecture aspects of a platform. Consequently, it becomes crucial to understand how these activities complement one another (McIntyre and Srinivasan, 2017).

4.2. Reinterpreting Platforms Using a Service-Dominant Logic

To systematically address the inherent challenge posed by the "distributed nature" of platforms (de Reuver et al., 2018) and to overcome the limitations associated with the two separate perspectives, we propose a reinterpretation of platforms that draws on the conceptual foundations of S-D logic, as previously discussed (Lusch et al., 2008; Vargo and Lusch, 2016, 2008, 2004). In doing so, we explore commonalities among the various ontological positions of platforms, drawing from the conceptual work (Tawana et al., 2010; de Reuven et al., 2018; and Li and Kettinger, 2021), complemented by other literature included in our sample. We acknowledge that some readers may perceive platforms and the S-D logic differently due to their distinct connotations. However, instead of a disadvantage, we see this as an opportunity because novelty and insightfulness arise from a broad understanding and then more specific synthesizing (Leidner, 2018; Schultze, 2015). Accordingly, at this point, our focus is to demonstrate the feasibility of applying S-D logic to understand platforms. Table 3 showcases a broad conceptual alignment between the conceptual foundations of S-D logic and the platform constructs extracted from the literature.

Table 3

Reinterpreting Platforms Based on Service-Dominant (S-D) Conceptual Foundations (CF)

S-D Foundation	**Platform as a Multi-Sided Network**	**Platform as a Modular Architecture**
CF1. Operant resource	Matchmaking	Self-reinforcing
CF2. Resourcing	Value co-creation is associated with facilitating network effects.	Value co-creation is associated with enabling generativity.
CF3. Servicing and experiencing	Transforming interdependencies (e.g., selling and buying) into service provisioning	Transforming complementary modules (e.g., apps) into service provisioning

CF4. Value proposing	Value proposition of information brokering, with actors on different sides as value co-creators	Value proposition of boundary resourcing, with actors as value co-creators
CF5. Dialog	Engaging actors on different sides to understand and transform use behaviors	Engaging different actors (e.g., developers and users) to understand and transform situational needs
CF6. Value creation network	Coordinating supply-demand externalities between actors on different sides, outsourcing transactions to the actors	Developing boundary resources and executing governance mechanisms, outsourcing complementary modules to end users and third parties
CF7. Learning	Learning from the feedback effects from actors on different sides	Learning from the performance of complementary modules
CF8. Collaboration	Developing value provision to enable more comprehensive service	Developing value provision to improve service quality and extend service range

When viewing a platform as a multi-sided network, the capability to facilitate instant matchmaking between demand and supply becomes the fundamental operant resource that implies a platform's core value (de Reuver et al., 2018; Li and Kettinger, 2021). Such value is achieved by facilitating network effects, especially indirect network effects, between various groups of actors (McIntyre and Srinivasan, 2017; Wessel et al., 2017). The significance of a platform is in serving interdependencies among actors from different sides by facilitating transactions (Tan et al., 2019; Zhu et al., 2021; Zimmermann et al., 2018), with supply-demand information brokering as its value proposition (Hein et al., 2020). To do so, a platform should allow communications between the actors and transform their behaviors into better matchmaking service, thereby forming a stronger supply-demand network around the platform (de Reuver et al., 2018). The platform evolves based on the feedback loops from actors and enables more comprehensive service (Eisenmann et al., 2011).

When considering a platform from the perspectives of a modular architecture, its core value lies in self-reinforcing, defined as the capability to facilitate the evolution of a technology through an extensible foundation that attracts contributions from third parties (Ceccagnoli et al., 2012; Spagnoletti et al., 2015; Tiwana et al., 2010). Value creation occurs when a platform achieves generativity—the capacity to produce unprompted change driven by heterogenous actors (Cennamo and Santaló, 2019; Sun et al., 2021). Generativity is manifested through specialized modules (e.g., apps) developed by third parties to address situational needs (Li and Kettinger, 2021). Thus, the key value proposition resides in effectively managing the boundary between various modules to ensure diversity without sacrificing integration (Tiwana et al., 2010). In other words, the platform must actively engage heterogeneous actors to comprehend their situational needs and transform those needs into service to satisfactorily address the needs. In this instance, the value creation network is coordinated by placing boundary resources (Ghazawneh and Henfridsson, 2013) and implementing corresponding governance mechanisms (Huber et al., 2017). Learning from performance indicators (such as end use experience and developer feedback) as well as continuously improving service quality and expanding service range is important for platform evolution (Eaton et al., 2015).

In general, using the S-D logic as a lens, a more systematic understanding of platforms emerges, covering both the economic network and the architectural design perspectives. In essence, a platform can be broadly viewed as a resource coordinator that facilitates supply-demand matchmaking and self-reinforcement by coordinating access to core computing power, harnessing contributions from heterogeneous actors, and evolving through iterative feedback loops.

5. Analyzing Platform Literature Against Service-Dominant Themes

The analysis above implies that applying S-D logic to understand platforms is feasible. However, we still need a more comprehensive framework to tie the fragmented ontological components of platforms together. As described previously, the three central themes of S-D logic (i.e., actor-to-actor networks, resource distribution, and resource integration) introduced by Lusch and Nambisan (2015) provide a base for our literature analysis and theorizing for three key reasons. First, the three themes are derived from the axioms and conceptual foundations of S-D logic (Vargo and Lusch, 2016),

providing a coherent and solid theoretical foundation. Second, the three central themes allow us to consider that a platform can have multifaceted dimensions, inviting further exploration of its deeper structure. Third, given that the three central themes are developed for IS research, they indicate the importance of IS capabilities as the operant resource for service and value co-creation in the platform context (Lusch and Nambisan, 2015). Thus, the three central themes of the S-D logic convey various facets of the platform concept, enabling us to delve deeper into their underlying structure and explore the fundamental IS capabilities that support these facets. Appendix B shows the coding and analysis process employed to identify the dimensions associated with each theme, based on our examination of our sample of 77 empirical papers. Table 4 provides an overview of the dimensions that have been identified for each theme. These dimensions and their relationships to the themes are described further below.

Table 4

Platform Dimensions Identified for S-D Logic Themes

S-D Logic Theme	Dimension	References
Actor-to-actor networks	Providers' value perceptions	(Benlian et al., 2015; Goldbach et al., 2018; Hong et al., 2020; Jiang et al., 2018; Kankanhalli et al., 2015; Kim et al., 2016; Liang et al., 2021; Tiwana, 2015a)
	Beneficiaries' value perceptions	(Akhmedova et al., 2021; Huang et al., 2017; Lu et al., 2021; Ryu and Suh, 2021; Shim et al., 2018; Taudes et al., 2000; Thies et al., 2016; Wright et al., 2017)
	Shared vision	(Cheng et al., 2018; Hong and Pavlou, 2017; Idowu and Elbanna, 2021; Lee et al., 2018; Yaraghi et al., 2015)
	Multihoming	(Cennamo et al., 2018; Kwon et al., 2017; Yang et al., 2021; Zhu et al., 2021)
Resource distribution	Architecture	(Brunswicker et al., 2019; Kazan et al., 2018; Spagnoletti et al., 2015; Sun et al., 2021)

	Boundary resource	(Eaton et al., 2015; Foerderer et al., 2019; Ghazawneh and Henfridsson, 2013; Karhu et al., 2018)
	Boundary governance	(de Lima Fontão et al., 2019; Floetgen et al., 2021; Grøtnes, 2009; Huber et al., 2017; Leong et al., 2019; Nielsen and Aanestad, 2006; Wessel et al., 2017)
Resource integration	Value for providers	(Banker et al., 2011; Ceccagnoli et al., 2012; Li et al., 2019, 2018; Mäntymäki et al., 2019; Qiu et al., 2017; Tiwana, 2018; Ye and Kankanhalli, 2020)
	Value for beneficiaries	(Claussen et al., 2013; Hukal et al., 2020; Masiero and Arvidsson, 2021; Najmul Islam et al., 2020; Nwankpa and Datta, 2021; Rai et al., 2006a; Rolland et al., 2018; Sedera et al., 2016; Shaw and Holland, 2010; Tiwana, 2015b; Xu, 2021; Ye and Kankanhalli, 2018)
	Value for operators	(Anderson Jr. et al., 2014; Bakos and Katsamakas, 2008; Niculescu et al., 2018; Oh et al., 2015; Ondrus et al., 2015; Parker et al., 2017; Song et al., 2018; Thies et al., 2018; Wulf and Blohm, 2020; Zhou and Song, 2018)
	Value provision	(Alaimo et al., 2020; Foerderer et al., 2018; Hann et al., 2016; Saarikko et al., 2019; Schreieck et al., 2021; Tan et al., 2015, 2019)

5.1. Theme 1: Actor-to-Actor Networks

Lusch and Nambisan (2015, p. 161) described an actor-to-actor network as "a relatively self-contained, self-adjusting system of mostly loosely coupled social and economic (resource-integrating) actors connected by shared institutional logics and mutual value creation through service exchange". In an actor-to-actor network, all parties are both value providers and beneficiaries, sharing the institutional logic required to actualize the service buried in the included resources (Lusch and Vargo, 2006). Accordingly, in Theme 1, the literature has investigated the intentions of providers and beneficiaries to

form a network, their shared vision within the network, and their multihoming decisions when multiple options are available.

One group of actors consists of providers who possess specialized knowledge and capabilities to initiate direct use value on a platform. Examples include app developers for mobile platforms, drivers for ride-hailing platforms, and lenders for peer-to-peer platforms. Broadly, the literature discusses two categories of providers' intentions to participate in a platform at the individual level. The first category focuses on the anticipated benefits and their impact. For example, Kankanhalli et al. (2015) demonstrated a positive relationship between expected benefits (i.e., enjoyment, extrinsic reward, and recognition) and developers' intention to contribute to a mobile platform. In a similar vein, Liang et al. (2021) found that tool owners were hesitated to register on resource sharing platforms when they perceived high transaction costs (less anticipated benefits). The second category focuses on the impact of platform autonomy on providers' intention to contribute to a platform. Specifically, having clear service review guidance (Kim et al., 2016) and allowing more self-controlled activities (Goldbach et al., 2018) increase providers' dedication to a platform because the providers perceive higher autonomy (Benlian et al., 2015). Furthermore, receiving strong technology toolkit support (e.g., offering APIs and SDKs) is an important indicator of providers' continuous participation (Kankanhalli et al., 2015; Kim et al., 2016).

The other group of actors consists of beneficiaries who shape and refine service by consuming the direct use value of a platform. Some examples include users of mobile platforms, buyers of e-commerce platforms, and adopters of enterprise system platforms. This stream of literature focuses on examining two groups of antecedents to beneficiaries' platform participation: service satisfaction and perceived effectiveness of institutional structures. Specifically, beneficiaries are loyal to a platform when they are satisfied with perceived technical (e.g., flexible to be integrated with other complements) and social gains (e.g., enjoyable user experience) (Akhmedova et al., 2021; Ryu and Suh, 2021; Taudes et al., 2000). Furthermore, the literature finds both casual and moderating effects of institutional support (e.g., privacy projection and risk mitigation) on beneficiaries' intention to join a platform (Huang et al., 2017; Lu et al., 2021). The institutional structure also includes organizational (e.g., top management support)

and environmental factors (e.g., competitive pressure) that determine whether a firm decide to assimilate an enterprise platform (Shim et al., 2018; Wright et al., 2017).

An antecedent that affects both providers' and beneficiaries' intention of joining a platform is herding. Herding describes providers' and beneficiaries' response to the prior experiences of their peers on a platform. From the providers' perspective, Jiang et al. (2018) found that herding (e.g., predecessors' action) existed when lending providers make decision to join a peer-to-peer platform and its effect was attenuated by time. From the beneficiaries' perspective, Thies et al. (2016) found that the funding decisions made by predecessors have a significant predictive power on one's willingness to use a crowdfunding platform. Shim et al. (2018) observed a similar phenomenon that herding was prevalent in a firm's enterprise platform adoption.

Having considered providers' and beneficiaries' intentions to participate in a platform, another important stream of literature has explored the shared vision between them. For example, some literature has examined factors such as digital identity (e.g., reputation), nature of task (e.g., context specificity), and social environment (e.g., cultural differences) that form the relationship between providers and beneficiaries (e.g., task selection and delivery) on crowdsourcing platforms (Hong and Pavlou, 2017; Idowu and Elbanna, 2021). Similarly, in a ride-hailing context, the literature had found that common factors such as platform service quality, trust in platform functionality, and perceived cost-benefit are positively associated with providers' and beneficiaries' willingness to start using a platform (Cheng et al., 2018; Lee et al., 2018). Although the literature has not empirically examined platforms beyond crowdsourcing and ride-hailing, the shared vision between providers and beneficiaries is likely applicable to other contexts, considering the inherent two-sided nature of platforms.

Finally, the literature has explored factors that can influence providers' and beneficiaries' decision to join multiple platforms. In general, providers need to consider service parameters (e.g., quality and price) and accessibility (e.g., access to broader resources) when deciding whether to engage in multihoming (Cennamo et al., 2018; Yang et al., 2021). Furthermore, transaction costs (e.g., cost of adopting an additional platform) and intraplatform capabilities (e.g., competitiveness and compatibility) influence both providers' and beneficiaries' multihoming decision-making (Kwon et al., 2017; Zhu et

al., 2021). The concept of platforms is inherently a cross-level phenomenon, benefiting from variety and flexibility in a cross-platform approach (Tiwana et al., 2010). The literature on multihoming extends the platform discussion to encompass service exchange across multiple technology settings.

5.2. Theme 2: Resource Distribution

With this theme, the literature generally expects a platform to be flexible enough to support the situational needs of heterogenous actors, while also being stable enough to foster and strengthen connections between actors and computing resources (de Reuver et al., 2018; Tilson et al., 2010; Tiwana et al., 2010). To achieve such simultaneous flexibility and stability, platforms should function as "a modular structure that comprises tangible components (resources) and facilitates the interaction of actors and resources (or resource bundles)" (Lusch & Nambisan, 2015, p. 166). Thus, a platform serves as the venue where resource distribution occurs. Specifically, the literature has explored aspects such as a platform's overall architecture, boundary resources, and boundary governance.

A platform architecture describes the conceptual structure of various components and their ontological relationships associated with a platform (Sun et al., 2021). A multi-layered architecture emerged in our review, encompassing a technology core (e.g., database infrastructure), an interface (e.g., APIs), and complements (e.g., apps) (Spagnoletti et al., 2015; Sun et al., 2021). To enable the functioning of such a multi-layered architecture, the literature introduces the concept of decoupling, which means that changes in one layer do not affect the performance of other layers (Tiwana et al., 2010). Decoupling reflects a platform operator's design strategy, which can be competition-driven or market-driven (Brunswicker et al., 2019), as well as inward, outward, or hybrid (Kazan et al., 2018). Managing decoupling usually involves control devolution, where a platform operator relinquishes control to providers. This control devolution is based on factors such as computing resource distribution, risk tolerance, and innovativeness (Nielsen and Aanestad, 2006). Thus, the architecture, characterized by decoupling between different layers, determines the assimilation of complex resource distribution activities.

Boundary resources (e.g., APIs and SDKs) are "software tools and regulations that serve as the interface for the arm's-length relationship between the platform owner [operator] and the application developer [provider]" (Ghazawneh and Henfridsson, 2013, p. 174). The literature has examined how

boundary resources navigate the arm's-length relationship between various actors. Specifically, the literature has identified the trade-off between flexibility and stability as the key challenge that boundary resource design should address. Ghazawneh & Henfridsson (2013) describe this trade-off as the art of balancing between resourcing and securing. On a mobile platform, resourcing stimulates external contributions (e.g., third-party apps), while securing maintains control over these contributions. Similarly, Foerderer et al. (2019) describe this trade-off as a careful balance between enabling scalability of knowledge and retaining knowledge at the appropriate scope on an enterprise platform. In this case, designing boundary resources is an ongoing process that is shaped and reshaped by the cascading actions of accommodating and rejecting certain actors and their attempts to access the core of the architecture (e.g., source codes) (Eaton et al., 2015; Karhu et al., 2018).

Governance mechanisms are practices that assign decision rights to support value (co)creation on a platform (Tiwana et al., 2010; Wareham et al., 2014). The literature explores two broad groups of governance mechanisms: relationship coordination and access control. Complex relationships exist as networks of multiple actors (e.g., providers, beneficiaries, and operators[6]) on a platform (Leong et al., 2019). By engaging in boundary spanning processes that enable high-quality information sharing and human relation management, as well as building digital repositories that allow effective digital resource distribution in the network, operators implement governance mechanisms to better serve providers and beneficiaries (de Lima Fontão et al., 2019; Leong et al., 2019). Furthermore, although the underlying logic of a platform is to be open to opportunities, access control associated with the operator's strategy is critical (Wessel et al., 2017). In this scenario, innovation-driven operators are more likely to grant access control to other actors than quality-driven operators (Grøtnes, 2009). Likewise, economic costs (e.g., granting access to core computing resources for innovation and diversity is associated with higher costs) also influence the implementation platform governance (Huber et al., 2017).

5.3. Theme 3: Resource Integration

Lusch and Nambisan (2015) argued that the foundation for a S-D ecosystem is value co-creation enabled by integrating multiple resources and incorporating values for different actors. As discussed

[6] In a platform context, operators often refer to the owner or designer of the technology architecture, such as Apple for iOS, who act as the intermediaries and derive benefits from value exchange.

for Theme 2, platforms have been extensively regarded as a venue where various actors co-create value through intricately designed and implemented resource distribution (Ceccagnoli et al., 2012; Huber et al., 2017; Schreieck et al., 2021). Following S-D logic, Theme 3 further complements our understanding of platforms by exploring the distinct values for each actor and value provisioning activities. In particular, the literature first identifies and describes the value that a platform can deliver to providers, beneficiaries, and operators, respectively. Then, the literature provides in-depth discussions about how a platform operator creates a value co-creation environment and organizes resource integration processes.

From the providers' perspective, the literature focuses on the enhanced business performance and advanced capability that a provider can gain after joining a platform. Research on business performance has examined providers' financial indicators and competitive advantages after joining a platform. Most of the studies focused on the advantages and demonstrated, for example, that joining a platform is generally associated with higher commodity prices (Banker et al., 2011), better revenue performance (Ye and Kankanhalli, 2020), an increase in sales (Li et al., 2019), and a greater likelihood to receiving initial public offerings (Ceccagnoli et al., 2012). Although research on the value for providers derived from platform architecture remains limited, Tiwana (2018) took a design angle and found that a provider (app developer) could gain a competitive advantage by effectively leveraging platform capabilities (operating functions) through a combination of the internal integrity and external coupling of the service (apps). Furthermore, some literature has noted that providers can gain advanced capabilities after participating in a platform (Li et al., 2018; Mäntymäki et al., 2019; Qiu et al., 2017). These capabilities are reflected in the flexible working relationships (e.g., paring drivers and riders) and value co-creation practices (app development) offered by a platform. However, these gains are often moderated by the arm's-length interaction with the platform operator.

From the beneficiaries' perspective, value exists at both the individual and organizational levels. At the individual level, the literature views value for beneficiaries in terms of service quality and quantity (Claussen et al., 2013; Xu, 2021). Service quality refers to the rating and number of active users of a service. Beneficiaries are more likely to enjoy high quality services (e.g., apps for a mobile platform) when the platform offers dedicated internal control over development autonomy (Tiwana, 2015b) and

incorporates user feedback to make rule changes (Claussen et al., 2013). Service quantity refers to the volume and diversity of services. Specifically, beneficiaries can expect a greater number of services when the platform is more opportunity-driven and allows for stronger design autonomy (Hukal et al., 2020; Ye and Kankanhalli, 2018). The value for beneficiaries at the organizational level is markedly different from that for individuals. At the organizational level, firms as platform beneficiaries can benefit from advanced capabilities (Najmul Islam et al., 2020; Rai et al., 2006a; Rolland et al., 2018). Although the literature has been conducted in different organizational contexts, two general capabilities – business process integration and innovativeness – have emerged. For example, Shaw and Holland (2010) found that a platform (electronic market) could assist firms in coordinating the alignment between external resources (customer requirements) and internal processes (cross-units collaboration) to achieve different configurations of solutions. Furthermore, organizations using enterprise platforms often outperform by being innovative, i.e., experimenting with new ways of delivering services and offering unique solutions to customers (Sedera et al., 2016).

From the operators' perspective, network effect stands out as the predominant value a platform operator can create and capture, as highlighted in most of the literature we reviewed (Anderson Jr. et al., 2014; Parker et al., 2017; Song et al., 2018). What unifies the literature is a substantial number of references to the same-side network effect (direct network effect), which aligns with the traditional idea that the value of network participation for an actor depends on the number of other actors with whom they can interact. For example, operators of e-commerce platforms should prioritize making sufficient investments to ensure the participation of one side (sellers) before focusing on extracting surplus from other sides (buyers) (Bakos and Katsamakas, 2008). However, other works that reference network effects have paid more attention to the cross-side network effect (indirect network effect), which highlights how actors on different sides (providers and beneficiaries) can mutually benefit from the size and characteristics of the opposite side. For example, the literature generally agrees that a platform operator's return on investment and measure of success rely on the cross-side network effect, which is influenced by the number and diversity of services built on the platform (Thies et al., 2018; Zhou and Song, 2018). Increasingly, both same-side and cross-side network effects play important roles as the underlying value in platform operators' strategy. This imprint is evident in the literature on the network

effect-driven market potential (Niculescu et al., 2018; Ondrus et al., 2015) and the profitability (Parker et al., 2017; Wulf and Blohm, 2020) of a platform.

Finally, to support the effective incorporation of distinct values among heterogeneous actors, a platform operator needs to facilitate integration between providers, beneficiaries, and other actors, which necessitates resource provision on the platform. Resource provision is an umbrella term derived from the literature, covering a range of organization practices that underpin platform development and management (Alaimo et al., 2020; Saarikko et al., 2019; Tan et al., 2015). Specifically, the configuration between different actors on a platform necessitates higher levels of knowledge spanning capability (Foerderer et al., 2019), embraces intergenerational compatibility (Hann et al., 2016), and cultivates technology- and relationship-driven capabilities (Schreieck et al., 2021). Despite the prominence of an operator's resource provisioning practices, the core of operational resilience lies in their capability to respond to changes and uncertainties. Such a capability is embedded in the operator's organizational resilience as they design, facilitate, and modify the architecture and governance mechanisms of the platform (Floetgen et al., 2021). In addition, it involves IT-enabled operational agility to deliver an effective sensing and response mechanism (Tan et al., 2019).

5.4. Summary and Reflection

Our literature review revealed the breadth and diverse territory of platform-related phenomena in IS research. Based on the S-D logic framework (Lusch and Nambisan, 2015), we identified 11 dimensions grouped under three central S-D themes, as shown in Table 5. These dimensions serve as the building blocks for our theoretical synthesis in the next section. By doing so, we understand platforms as a multidimensional concept, providing a more comprehensive and theory-driven treatment. To inform further conceptualization and theorizing, we offer two critical reflections based on the literature review.

Table 5

Building Blocks of the S-D Platform Framework

Dimension	Theme and Description
Theme 1: Actor-to-actor networks	

1. Providers' intention to participation	Providers are actors who possess specialized knowledge and skills to initiate direct use value on a platform. This dimension emphasizes the significance of anticipated benefits, platform autonomy, and herding in influencing providers' decision to participate in the platform.
2. Beneficiaries' intention to participation	Beneficiaries are actors who possess the knowledge to shape and refine the value exchanged on a platform. This dimension emphasizes the significance of provider service satisfaction, perceived effectiveness of institutional structure, and herding in influencing beneficiaries' decision to participate in the platform.
3. Shared vision	This dimension captures the shared view of providers and beneficiaries on a platform. It examines factors, including the nature of tasks and perceived platform service quality, contribute to the formation of a common ground for value exchange between providers and beneficiaries.
4. Multihoming	This dimension captures the factors that influence providers' and beneficiaries' evaluation of multiple platforms. These factors encompass platform service characteristics and intraplatform capabilities for providers, as well as accessibility and transaction costs for both providers and beneficiaries.
Theme 2: Resource distribution	
5. Architecture	This dimension explains the multi-layer architecture of a platform and highlights decoupling and generativity as key characteristics that distinguish platforms from other systems.
6. Boundary resource	This dimension highlights the importance of boundary resources in navigating the trade-off between flexibility and stability, which is recognized as a key challenge in platform design and governance.
7. Boundary governance	This dimension explains governance mechanisms that coordinate the complex relationships among heterogeneous actors and the role of access control.
Theme 3: Resource integration	

8. Value for providers	This dimension explains the key values that a platform can generate for providers, including enhanced business performance and advanced capabilities.
9. Value for beneficiaries	This dimension explains the key values that a platform can generate for beneficiaries, including service quality and quantity, as well as advanced capabilities.
10. Value for platform operators	This dimension explains the key values, specifically same-side and cross-side network effects, that a platform can generate for its operators, who is an actor with specific knowledge and skills to initiate and manage the platform.
11. Value provision	This dimension highlights the importance of the capability in incorporating the diverse values generated for different groups of actors on a platform, which plays a crucial role in driving the platform towards success.

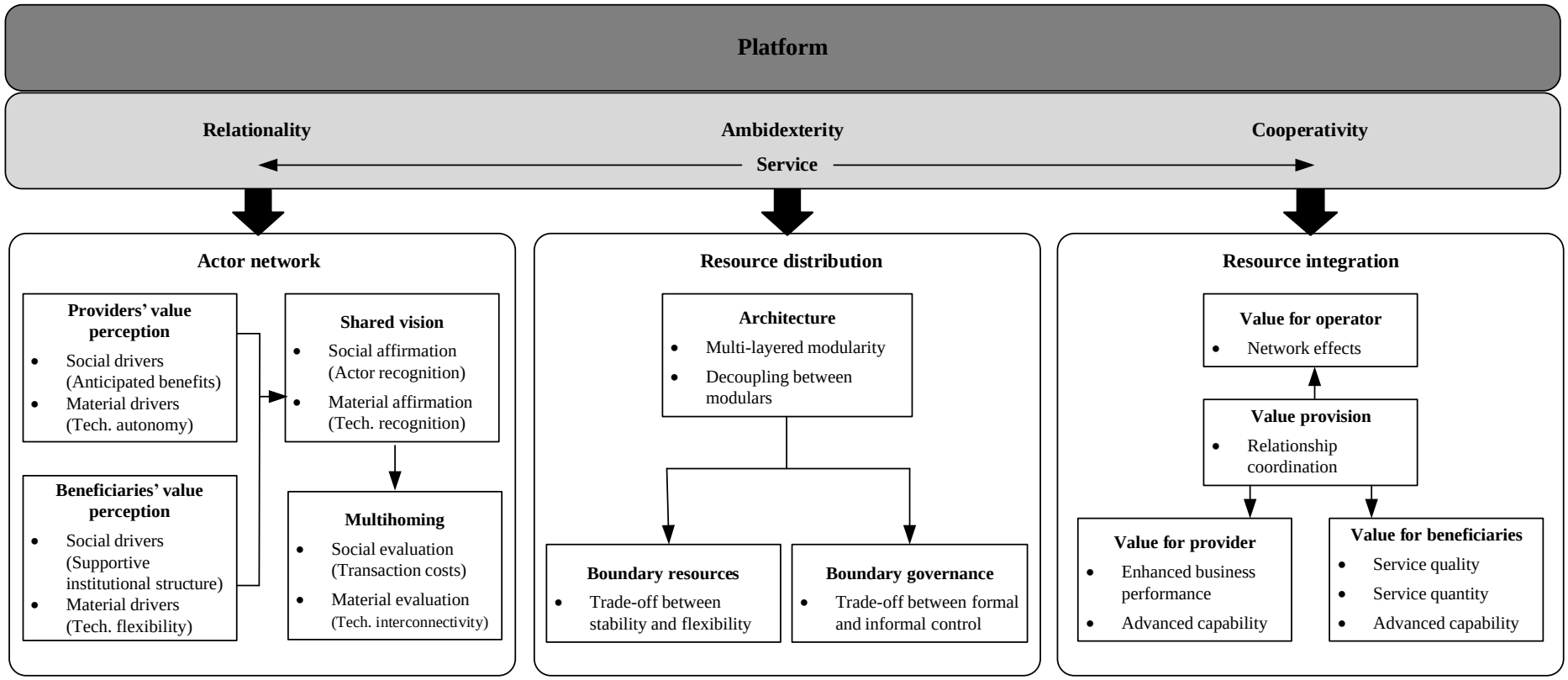
First, although the literature provides a strong empirical foundation for the unidimensional definition of platforms as either a multi-sided market or a complex modular system, there is a growing recognition of the multidimensional nature of platforms (Li and Kettinger, 2021; McIntyre and Srinivasan, 2017). However, the conceptual dimensions of platforms are still subject to debate and disagreement (de Reuver et al., 2018). The literature has explored and examined various aspects of platforms, including adoption (Fichman, 2004), design (Sun et al., 2021), strategy (Tan et al., 2015) and network externalities (Anderson Jr. et al., 2014). Such diversity arises from variations in research contexts, conceptual foundations, and theoretical grounding. Although diversification has led to remarkable insights into platforms as an emerging and important research topic, it can also pose challenge due to the increasing complexity in understanding the types, measurement, and operationalization of platforms (de Reuver et al., 2018). Furthermore, although literature has reached a consensus on the important role of technology in understanding platform-related phenomena, it tends to adopt a nominal view of technology. That is, technology is often portrayed as a label without delving into a comprehensive interpretation of how it transforms value co-creation in the context of a platform.

Second, echoing the above reflection, a multidimensional conceptualization of platforms necessitates a thorough discussion of the level of abstraction and modeling of the underlying dimensions.

Although the literature has investigated a wide range of platform-related phenomena, there has been a tendency to narrowly approach the level of abstraction in these investigations. To analyze the coexistence of different dimensions, a higher order conceptualization of platforms is needed. That is, in addition to identifying and analyzing the themes, it is advocated to take a more holistic view of platforms as an important theoretical construct. Thus, the conceptual and relational disposition of the platform construct and its dimensions become more focused and defined, leading to an increase in its theoretical relevance (Dubin, 1978). In addition, a higher order and more comprehensive conceptualization of platforms that considers the interaction and integration between the conceptual dimensions derived from the literature facilitates a socio-material approach to understand platforms as a complex IS phenomenon, which is a defining aspect of IS research (Sarker et al., 2019). Thus, further research regarding a more integrative reconceptualization of platforms in IS research is worthwhile.

6. Reconceptualizing Platforms as a Unique IS Capability for Value Co-Creation

Figure 1 shows the newly developed S-D Platform Framework, which reconceptualizes platforms in an integrated manner. This framework incorporates the 11 platform dimensions (see Table 5) extracted from the literature. It offers valuable insights into the intricate and multifaceted nature of platforms in IS research, adhering to the three S-D themes: actor-to-actor networks, resource distribution, and resource integration. As a further step in theoretical development, we abstracted the three S-D themes to three higher-level facets that encapsulate the essence of platforms as a unique IS capability, namely: *relationality*, *ambidexterity*, and *cooperativity*, respectively. This theorizing step is the outcome of an interpretive act (Leidner, 2018; Schultze, 2015). Specifically, as Leidner (2018) suggests, we embrace theoretically less-integrated elements and incorporate them into synthesis. These higher-level platform facets are described further below.



Note: Normal arrows represent logic flows between platform dimensions. Bolded arrows represent revised higher-level notions underpinning platform dimensions. Content in brackets shows examples of conceptual items (i.e., bullet points) derived from the literature review.

Figure 1. S-D Platform Framework

6.1. Relationality Underlies the Actor Network

Following S-D logic, an actor network represents a collective of loosely coupled actors who possess diverse yet interconnected social and material perceptions of value creation. The formation of a "shared worldview" is essential for bringing together the cognitively distant actors within the network (Lusch and Nambisan, 2015). However, the important question that remains unanswered pertains to the activation of this shared worldview. To address this question, we introduce the notion of *relationality*. In the social constructionist paradigm of service research, human perceptions of value are contingent upon human practices, constructed in and influenced by interactions between individuals and their environment (Crotty, 1998; Zeithaml et al., 2020). By incorporating the social constructionist paradigm, relationality emphasizes that humans and materials "relationally entail or enact each other in practice" in the socio-technical aspect of IS research (Cecez-Kecmanovic et al., 2014; Orlikowski, 2007, p. 1438; Sarker et al., 2019). It recognizes the importance of bringing together the diverse social identities of actors and the characteristics of artifacts that surround them in attaining a common institutional arrangement. Using relationality as an explanatory notion for the actor network aligns with the S-D axioms, where actors actively participate in the creation and offering of value propositions rather than simply producing value, and these value propositions encompass diverse institutions harmonized through shared institutional arrangements among the actors (Vargo and Lusch, 2016).

Based on our literature review and echoing the preceding discussion, the actor network begins with the emergence of value perceptions held by providers and beneficiaries. These perceptions consist of social and material motivations of both actors (provider and beneficiary). On the provider side, the perception arises from an interplay between anticipated benefits (e.g., perceived emotional and financial rewards) and technological autonomy (e.g., toolkit support for service development). On the beneficiary side, the perception emerges from an interplay between trust (e.g., interpersonal trust and trust in institutional structures) and technological flexibility (e.g., being compatible with complementary services). Thus, on both sides, we can observe interactions between actors' value propositions driven by social and material perceptions.

These interactions give rise to a shared vision of value exchange between providers and beneficiaries. While the literature presents various factors that can shape the shared vision, we can identify two broad categories based on the socio-material construction: social affirmation and material affirmation. *Social affirmation* emphasizes that providers acknowledge the significance of beneficiaries' characteristics (e.g., sources of requirements and refinement); in the meantime, beneficiaries recognize the characteristics of providers (e.g., sources of direct use value), for value exchange. *Material affirmation* highlights the recognition by both providers and beneficiaries that using technology can facilitate their value exchange activities. At this stage, when the shared vision is derived from the social-material interactions of providers' and beneficiaries' various perceptions, a technology architecture of participation emerges to coordinate actors and their service exchange (Lusch and Nambisan, 2015). As multiple architectures emerge, providers and beneficiaries naturally face the need to evaluate which one(s) to join. Similarly, social (e.g., transaction costs) and material factors (e.g., technological interconnectivity) influence the multihoming evaluations of both providers and beneficiaries.

Building on the S-D logic, which posits that value co-creation emerges from an actor-to-actor network comprising loosely coupled actors connected by shared institutional logics (Lusch and Nambisan, 2015), we propose that relationality formalizes and strengthens such a network. Specifically, our framework inherits from S-D logic by highlighting the importance of fostering a shared worldview among loosely coupled actors within the network. Importantly, our framework also extends S-D logic by explicitly elucidating relationality as the foundation for the accumulation of diverse social and material perceptions value exchange. Having such a common ground is important because the determination of value always remains unique to the value propositions put forth by the beneficiary actors[7] (Vargo and Lusch, 2008). Here, we relabel "actor-to-actor network" as "actor network" because the shared vision bonds loosely coupled groups of actors together as value co-creators and blurs the boundaries between them. The actor network accommodates mutual recognition among actors while also embracing specific socio-material-driven value perceptions within each group of actors through relationality. Thus, *relationality underlies the first facet of platforms, defined as the capability to bring*

[7] According to Vargo and Lusch (2016), given the reciprocal service exchange, service provider also has the role of beneficiary. Thus, beneficiary here describes the broad relational role of the actors who capture the beneficial impact of service.

together heterogeneous actors with diverse yet interconnected socio-material perceptions of value creation, leading to an actor-generated institutional agreement for value exchange.

6.2. Ambidexterity Underlies Resource Distribution

In line with the S-D logic, resource distribution entails a modular architecture that accommodates resources and facilitates their distribution among actors (Lusch and Nambisan, 2015). However, what remains unknown are the key challenges related to resource distribution and how to effectively address them in a platform context. A platform operator frequently confronts decisions regarding whether to prioritize investments in uncertain opportunities from heterogenous actors or to maintain business performance provided by a consistent system, even though they may aspire to excel in both aspects simultaneously (Tilson et al., 2010). In this case, a central challenge for a functional platform lies in finding the optimal coordination between the flexibility to seek new opportunities and the stability to maintain consistent performance (de Ruyter et al., 2020). Accordingly, we propose the notion of *ambidexterity*, which involves the simultaneous pursuit of dual goals that may appear to be conflicting. The genesis of ambidexterity has presented a promising approach to underscore resource distribution, as digital technologies introduce new dynamics to the modular architectural that serve as a basis for balancing flexibility and stability (Tiwana et al., 2010; Yoo et al., 2012). In addition, employing ambidexterity to interpret resource distribution aligns with the S-D axioms, which posit that value exchange often occurs indirectly (Vargo and Lusch, 2016, 2008), concealed beneath the surface of interactions and facilitated by a technology-enabled modular architecture (Lusch and Nambisan, 2015).

Echoing the above discussion, our literature review reveals that ambidexterity facilitates the seamless flow of resource distribution between actors across various architectural layers – such as device, network, service, and content (Yoo et al., 2010), technology base, interface, and add-on (Sun et al., 2021), or core, interface, and complement (Spagnoletti et al., 2015). In this instance, resources manifest themselves within a technological architecture where actors assume the dual role of resource providers and beneficiaries. For example, the lower layers (e.g., data infrastructure and virtualization) enable the conversion of a developer's app development capability into direct use value for end users at higher layers (e.g., applications). Simultaneously, the developer can harness usage data obtained from

end users at the higher layer. However, considering that actors and their needs are often context-specific, achieving generativity – a state of technology that enables spontaneous change driven by diverse and originally uncoordinated actors (Zittrain, 2006) – becomes the ultimate objective of ambidexterity. In particular, generativity "is accomplished through loose couplings across layers" (Yoo et al., 2010, p. 728) and should be "decoupled so that producers [actors] can easily mix and match the platform's design elements…" (Brunswicker et al., 2019, p.1249).

Against this backdrop, an interesting question arises regarding how to "dedicatedly" design and manage the loose couplings and decoupled modular architecture. More specifically, what is the optimal degree of looseness and decoupling for a modular architecture? In answering this question, we build on our literature review and recognize the importance of boundary resources and governance mechanisms. First, boundary resources serve the purpose of determining resource access by establishing specific conditions and delineating the actors involved. The essence of boundary resources lies in their capacity to transcend knowledge boundaries between heterogeneous actors and between actors and technology, thereby embodying ambidexterity (Foerderer et al., 2019). When it comes to specific design, boundary resources are primarily manifested through the use of standards that are codified in technological tools such as APIs and SDKs and embedded in social guidance such as user instructions and training materials. These tools and guidance enable flexible distribution of resources while ensuring the stable functionality of the overall architecture. Second, when shifting from a design perspective to a management perspective, governance mechanisms act as a higher-order manifestation of ambidexterity. In particular, governance mechanisms explain the timing and manner in which ambidexterity is regulated, whether through formal means such as rules or through informal means such as relationship development (Huber et al., 2017). Thus, governance mechanisms steer the evolutionary dynamics of resources distribution among heterogeneous actors (Wessel et al., 2017).

In general, ambidexterity underlies the venue where value exchange occurs. This venue is enabled by a technological setting with a modular architecture, empowered by boundary resources and governance mechanisms. Although Lusch and Nambisan (2015) have put forth related constructs such as modular architecture and rules of exchange, our analysis contributes new insights by doing the

following: (1) explaining the manifestation of ambidexterity within a technological setting; (2) refining the understanding of rules of exchange through boundary resources and governance mechanisms; and (3) highlighting the significance of effective ambidexterity in resource distribution for the functioning of a platform. These new observations are important as they provide valuable insights into addressing questions concerning how a platform attains generativity (Yoo, 2013) and how a platform strikes a balance between system consistency control and the need to embrace diversity for innovation (Tiwana et al., 2010). Thus, *ambidexterity underlies the second facet of platforms, defined as the capability to orchestrate resource distribution through a modular architecture that leverages boundary resources and governance mechanisms, leading to generativity*.

6.3. Cooperativity Underlies Resource Integration

In S-D logic, resource integration encompasses the necessity to "define key roles" of the heterogeneous actors and "describe the nature of value created or co-created by each actor role" (Lusch and Nambisan, 2015, p. 162). Due to varying value perceptions, it is inherent for the values co-created by diverse actors to differ. S-D logic identifies three broad roles in actualizing service into different values: the ideate, who benefits from bringing knowledge of needs to the value exchange; the designer, who benefits from leveraging resources to develop new services; and the intermediary, who benefits from cross-pollinating knowledge across the network (Lusch and Nambisan, 2015). However, considering the different values actualized by the diverse actors, which result from their collective value creation activities, effectively incorporating actors for synergetic value exchange becomes critical (Rapp et al., 2017). Thus, we propose the notion of *cooperativity* to serve as the foundation of resource integration, enabling the synergy of diverse values co-created amongst heterogenous actors. Cooperativity allows actors to complement each other in value consumption and co-creation, which implies the S-D logic axioms of the involvement of all actors in resource integration and the synergistic nature of value co-creation (Vargo and Lusch, 2016, 2008).

Our literature review identifies three primary groups of actors that play crucial roles in forming resource integration: providers, beneficiaries, and operators. First, providers assume the role of designers, offering service of production and configuring resources to deliver direct usability to the

network. They play a crucial role in shaping the direct use value and performance of the platform. Second, beneficiaries act as the idolators, offering service of consumption. They contribute by transforming their context-specific needs into envisioning better service with enhanced useability. Their feedback and preferences drive the evolution of service and shape the direction of future development of the platform. Third, operators serve as the intermediaries, possessing knowledge at the intersection between providers and beneficiaries. They actively seek opportunities to create a stronger network effect by facilitating connections between other actors. Their role is instrumental in fostering cooperativity and supporting overall value exchange on the platform. We expand on S-D logic by delineating the key roles and highlighting the distinct values associated with each actor group.

To gain a comprehensive understanding of how distinct values synergistically transform among different actors, we contend that the process of value provision assumes an important role. Value provision, primarily initiated by the operator, acts as the catalyst for value integration and is also complemented by the contributions of other actors. This value provision entails an emphasis on aligning value across heterogeneous actors, nurturing value exchange among these actors. Specifically, the development of a frontend hub (e.g., the App Store) is essential for effective resource integration (Foerderer et al., 2019; Saarikko et al., 2019). This hub should enable providers to gather insights into consumption preferences through learning mechanisms and feedback loops from beneficiaries, empowering them to inspire and refine their service through sensing and responses (Tan et al., 2019). Similarly, beneficiaries should have access to the expertise of providers, allowing them to leverage the expertise to accomplish tasks as needed (Hann et al., 2016). In addition, operators should have the ability to monetize the value exchange that takes place between providers and beneficiaries of the hub (Tan et al., 2015).

Platforms should facilitate the synergistic co-creation of distinct values through the cooperative activities of heterogeneous actors. Despite the distinctiveness of values consumed by each actor, the interconnection between providers, beneficiaries, and operators becomes more prominent. They rely on interdependence to exchange the co-created value. In this context, the effective incorporation of distinct value perspectives and alignment of the actual values co-created by heterogeneous actors becomes

crucial in addressing the inherent complexity of resource integration on platforms. Such inter-actor and inter-functional resource integration necessitates cooperativity, which transforms variations in values co-created and consumed among actors into synergistic outcomes. Thus, *cooperativity underlies the third facet of platforms, defined as the capability to seamlessly incorporate variations in value exchange and consumption among heterogeneous actors, fostering synergistic value co-creation.*

6.4. Synthesis

Taking into consideration all three facets of platforms, we reconceptualize platforms as

a multifaceted IS capability, encompassing relationality, ambidexterity, and cooperativity, that enables the effective leverage of digital technologies to shape an actor network and facilitate resource distribution and integration, ultimately driving value co-creation.

The three facets of platform are interconnected through knowledge transformation (i.e., service). Specifically, an actor network consisting of relationality to bring together heterogeneous actors with shared socio-material needs requires resource distribution with ambidexterity to effectively accommodate and address these needs. The impact of resource distribution, in turn, reshapes and evolves the needs within the actor network. In a similar vein, as resource distribution entails the collective process of retrieving and using computing capability from diverse groups of actors, where cooperativity among these actors becomes crucial for resource integration. The impact of resource integration, in turn, enhances and refines the process of resource distribution. Finally, similar to the connection between goals (objectives) and outcomes (performances) in system use (Burton-Jones and Straub, 2006), there is a mutual dependence between the collaborative actor network and the cooperative resource integration, which is sustained through feedback loops. Broadly, service here encompasses the process of exchange that involves supply-demand matchmaking and technology self-reinforcing, all in pursuit of value co-creation, which aligns with our reinterpretation of platforms through the S-D lens.

7. Platforms Through a S-D Lens: What's Next?

We have developed a framework (Figure 1) to reconcile the complexity of platforms – a concept extensively used in IS research but lacking theoretical grounding. This framework demonstrates that

platforms can be effectively theorized using S-D logic as a lens and adhering to S-D axioms. In this section, we present a research agenda for future studies on platforms, building on the S-D Platform Framework. When organizing the research agenda, we have considered two guiding principles: (1) our agenda primarily centers on the implications for operators' design and management strategies, while recognizing the potential implications for other actors such as providers, beneficiaries, and those under-explored by the literature; and (2) our research agenda is rooted in the facets of relationality, ambidexterity, and cooperativity, which are derived from our newly developed framework, aiming to provide insights into the process dynamics and evolution of platforms (de Reuver et al., 2018). Table 6 summarizes the agenda. The five avenues of research are discussed below in terms of three facets of IS capability – relationality, ambidexterity, and cooperativity.

Table 6

An Agenda for Future Research

	Relationality	**Ambidexterity**	**Cooperativity**
Research avenue 1: Identifying sources of service	• How do value perceptions develop and evolve among different actors? • To what extent are value perceptions influenced by the complexity of the social systems and technological environments in which they are embedded?	• Which group(s) of actors should have access to specific types of resources to achieve ambidexterity? • What are the effects of actors' diverse preferences on "ambidextrous" resource distribution? • Can ambidexterity be considered a digital capability? If so, how?	• How to identify and incorporate the direct and indirect network effects stemming from different actors? • What impact does technology have on the service provision? • What types of strategy and structure bolster (undermine) the service interface?
Research avenue 2:	• What mechanisms explain the (mis)alignment of	• How does the interplay between flexibility and stability (i.e., the extent of	• How to capture the direct and indirect network

Unfolding processes of service	value perceptions among actors? • What mechanisms explain the (mis)alignment of the social and technological interaction that shapes value perceptions?	control over resource distribution) unfold? • What is the role of technology in facilitating and coordinating value exchange? • What role do strategic interventions play in shaping technology-enabled ambidexterity?	effects arising from different groups of actors? • How does technology influence value integration and delivery between different actors? • How does the experience gained from survival feed into strategizing and design?
Research avenue 3: Defining antecedents and effects of service	• How do institutional environments influence the value perceptions of different actors? • How does the variation in actor requirements influence the technology architecture design?	• What are the determinants and outcomes of a more "controlled" platform? • What the determinants and outcomes of a more "open" platform?	• How to measure platform success? • What is the relationship between technology capability and platform success?
Research avenue 4: Examining triggers of service	• When is the optimal timing to invest in or withdraw from the development of a relational socio-technical perception for heterogeneous actors?	• How and when does the transition between flexibility and stability occur and unfold within and across different technological layers?	• How and when are value assessments influenced by interactions and interdependencies among different actors, and how does technology mediate this process?
Research avenue 5:	• What is the correlation between the varying perceptions of value among different actors and	• Under what conditions do positive and negative feedback loops shape resource distribution?	• Under what conditions do positive and negative relationships between different actors become

Explaining conditions of service	their decisions to form a network?		prominent, and how can technology mediate or moderate their effects?

7.1. Research Avenue 1: Identifying Sources of Service

The first research avenue is dedicated to the sources of service. First, regarding relationality, this research avenue acknowledges the heterogeneity in actors' participation perceptions, considering the varying requirements across social and material aspects. In this instance, human actors are the source of service. While the literature has primarily focused on providers' and beneficiaries' intentions in a static manner (Fichman, 2004; Kankanhalli et al., 2015; Liang et al., 2021), we encourage future research to delve into the evolutionary and socio-material nature of actors' value perceptions. This approach will foster a more comprehensive understanding of platform emergence. Specifically, future research can explore how actors' value perceptions evolve over time and, importantly, how such evolution is embedded in the social and technological environments. Gaining a better understanding of the dynamics of actors' value perceptions has significant implications for platform investment and marketing strategies (McIntyre and Srinivasan, 2017).

Second, regarding ambidexterity, this research avenue acknowledges that once technology has materialized actors' requirements, the technology itself becomes the source of service. In this vein, it is essential to understand the role of the technology, which has not been fully explained in the literature (Henfridsson and Bygstad, 2013; Tilson et al., 2010). We, in accordance with a recent study by Li and Kettinger (2021), suggest that ambidexterity can be a key to understanding ambidexterity as an enabler of service in a platform context. However, we extend Li and Kettinger (2021) by proposing two specific research opportunities: (1) exploring who can access which part of the technology to acquire what types of resources and what outcomes can be expected; and (2) investigating how can we understand ambidexterity as a technology capability for resource distribution, moving beyond its root as individual and organizational capabilities.

Third, regarding cooperativity, this research avenue acknowledges that the co-created value flows between different actors are facilitated by technology. Considering the service provision that emerges

as a result of the ambidextrous resource distribution, it is critical to explore cross-actor resource integration associated with resource coordination. Specifically, technology-enabled direct and indirect network effects have been examined as key indicators of platform performance (McIntyre and Srinivasan, 2017; Zhu et al., 2021). Integration between direct and indirect networks is necessarily explicit and real-time, creating additional levels of complexity. Drawing on the economic literature and methods, future research can make important contributions by investigating and examining the relationship between direct and indirect network effects and the mediating role of technology. In addition, developing the idea of resource integration between different actors offers unique opportunities to explore new types of strategies that can contribute to the development of a technology-enabled service interface.

7.2. Research Avenue 2: Unfolding Processes of Service

Research avenue 2 is dedicated to the processes of service. First, regarding relationality, this research avenue focuses on the alignment of different actors' various value perceptions. Although the literature has extensively examined different actors' value perceptions of joining a platform (Kankanhalli et al., 2015; Lee et al., 2018; Thies et al., 2016), little consideration has been given to the process of aligning these perceptions. We envision that future research can unpack how to reach the shared vision by aligning value perceptions between heterogeneous actors. Another interesting opportunity is to explore the alignment between the social and material constructs in actors' value perceptions. Our literature review shows that the mutual reliance on social and material drivers characterizes actors' value perceptions (Idowu and Elbanna, 2021; Lee et al., 2018). This mutual reliance underlies the view that a platform emerges and evolves along with the complimentary and mutual reinforcing of social and material affirmations. More studies of the deep structure of actors' value perceptions are needed to develop performative and socio-material theories of platform emergence.

Second, regarding ambidexterity, this research avenue focuses on navigating the degree of control over resource access and distribution. In general, the literature has indicated that dealing with the trade-off between relinquishing control for flexibility and retaining control for stability is a critical challenge for platform design and governance (Sun et al., 2021; Tiwana et al., 2010). Our study provides an

alternative view and shows that effectively navigating the trade-off should be considered as a capability (i.e., ambidexterity) rather than a challenge. Inspired by the notion of paradox (Smith and Lewis, 2011), future research should focus on exploring how technology facilitates the coexistence of flexibility and stability, particularly inherent in a multi-layered modular architecture. Likewise, the operator's strategic capability to shape and harness ambidexterity becomes a critical factor impacting effective resource distribution, which deserves further exploration.

Third, regarding cooperativity, this research avenue focuses on insights into value capture. Concerning value capture, there is a general agreement that the operator earns commissions by coordinating resource exchange between providers and beneficiaries (Wessel et al., 2017; Wulf and Blohm, 2020). However, the majority of research has adopted a top-down approach to access the impact of organizational strategies such as economies of scope in innovation (Karhu et al., 2018). More work is needed to evaluate bottom-up effects, specifically examining how technology affects value integration and capture. For example, platforms can be a promising foundation for studying advanced value capture mechanisms such as tailored advertising and dynamic pricing empowered by big data and artificial intelligence (Li and Kettinger, 2021). The experiences gained from the upward influences of technology can enrich the understanding of platform strategizing and provide useful insights for platform architectural design.

7.3. Research Avenue 3: Defining Antecedents and Effects of Service

Research avenue 3 is dedicated to the antecedents and effects of service. First, regarding relationality, this research avenue considers the external antecedents that affect actors' value perceptions and the internal variance of actors' value perceptions that affects platform design. As delineated in our review, the literature has examined a wide range of factors that motivate heterogeneous actors to form a network of resource exchange. However, research endeavors often overlook the potential mediating or direct causal effects of contextual conditions. Considering contextual conditions – such as individual and organizational awareness of energy efficiency, institutional environments, and rurality (Bonina et al., 2021; Hong and Pavlou, 2017) – may offer a more solid basis for studying the origination of a platform. In addition, our review shows that the literature has not paid much attention to the correlation between

actors' value perceptions and platform design. For example, sustainability is an important topic in IS research, and the awareness among actors of imminent environmental and societal problems is increasingly critical in terms of technology design (Dao et al., 2011). Thus, future research can examine how variance in actors' value perceptions may influence operators' platform design, particularly with regards to contextual conditions such as sustainability.

Second, regarding ambidexterity, this research avenue considers the determinants and effects of a more "controlled" and a more "open" architecture, respectively. As we have discussed, the function of a platform relies on ambidexterity, which can embrace both flexibility and stability through navigating control. However, the literature is generally interpretive or social constructionist in nature (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013; Huber et al., 2017; Sun et al., 2021). Nonetheless, the increasing maturity of computational research approaches has led to a rise in both theoretical and practical work on the factors associated with platform openness and control (Miranda et al., 2022). Thus, building on the foundation from the interpretive tradition, future research can bring together positivist, interpretive, and social constructionist methodologies to measure ambidexterity and examine the specific factors that may contribute to its development. Additionally, it is important to investigate the specific outcomes that can be expected from a more open (or controlled) platform.

Third, regarding cooperativity, this research avenue focuses on the measurement and determinants of platform success. Due to the various conceptualizations, perspectives, and research contexts, there is a considerable variation in how platform success is measured in the literature. For example, some studies have measured the success of a platform based on the market performance of its complements (e.g., apps) (Tiwana, 2015b), network effects (Ceccagnoli et al., 2012), or generativity (Yoo, 2013). However, from the operator's perspective, these different measures can be seen as complementary, as platform success is multifaceted in nature. Thus, we recommend that future research aims to develop a more comprehensive understanding of platform success by synthesizing the different measures. By doing so, researchers can provide a more holistic view for platform strategizing and enhance our understanding of the factors that contribute to overall platform success. Another important consideration is the link between technology and platform success. Although the literature has

highlighted the importance of technological functionality in platform success (Constantinides et al., 2018; Tiwana, 2015a), there is still an under-researched area concerning how operators leverage technology as an organization capability to synthesize resources through a service interface.

7.4. Research Avenue 4: Examining Triggers of Service

Research avenue 4 is dedicated to triggers of service. First, regarding relationality, this research avenue focuses on the rationale behind platform investment. Actors' value perceptions may change depending on factors such as the effect of herding (Jiang et al., 2018), institutional environment (Lu et al., 2021), and trend leadership (Kankanhalli et al., 2015). These factors are dynamic. For example, other actors (providers and beneficiaries) that one meets along when making decision to form a network may affect the final decision. Thus, the dynamics in actors' value perception formation can generate substantial community effect, which ultimately affects operators' platform investment decisions. Thus, we encourage future research to study when is the "best" time for operators to invest in or withdraw from a platform taking different actors' dynamic value perception formation into consideration.

Second, regarding ambidexterity, this research avenue focuses on the dimensionality of the platform architecture in realizing ambidexterity. The literature has extensively discussed the multi-layered modular architecture and explored generativity as an important outcome of such architecture (Li and Kettinger, 2021; Sun et al., 2021; Tilson et al., 2010). However, how different layers (modulars) relate to one another, which integrates as a hierarchical entirety for resource distribution, remains unknown. For example, some literature argues that standardization glues data, applications, and processes for integration and implementation in order for smooth interoperability across different components in a platform context (Rai et al., 2006a; Sun et al., 2021). Thus, future research can ask how flexibility and stability unfold, not only within each layer of a platform architecture, but also across different layers. Only after such questions are answered, can an operator understand how generativity can be actualized.

Third, regarding cooperativity, this research avenue explores the process of value co-creation through interactions with a multitude of actors. Specifically, there are several questions that require further exploration, such as understanding how interdependencies between different actors influence the value co-creation process and identifying effective strategies to facilitate these interdependencies.

Although our review shows that the value generated by a platform is highly actor- and context-dependent, the S-D logic suggests that resource-integrating actors are connected through direct interactions (Lusch and Vargo, 2006). Likewise, drawing on the service literature, "value may emerge as a potential condition that afterward acquires defined properties. The assessment of these properties denotes value outcomes of various types… the assessment of value is an ongoing and dynamic process for actors in the system…" (Zeithaml et al., 2020, p. 418). Thus, examining the interdependencies between different actors can be important when operators formulate their value capture and assessment strategies. In addition, the pervasiveness of technology as the service interface provides numerous opportunities for future research to rethink the mediator (and even the direct trigger) of the interdependencies. Technologies like data analytics and dashboard enable the service interface to be virtual and visible, moving away from the abstract of inter-actor interactions.

7.5. Research Avenue 5: Explaining Conditions of Service

The last research avenue is dedicated to the conditions of service. First, regarding relationality, this research avenue explains the nomological network in which actors' value perceptions are embedded. Although our review shows that the literature has examined a wide range of factors that can lead to actors' value perceptions, these factors have not been systematically synthesized. Indeed, enabled by technology, the interplay of different actors' value perceptions and their situated contexts continuously introduces new concepts, such as coopetition between providers and situational requirements from beneficiaries (Floetgen et al., 2021). Thus, it is important to gain a comprehensive view of the ways in which different actors perceive value and how a network can accommodate classic and new factors of value perceptions. One path towards such a comprehensive view is to synthesize extant research findings using meta-analytical or bibliometric endeavors to opt for an evolutionary roadmap of why and how a nomological network forms as the basis for platform emergence.

Second, regarding ambidexterity, this research avenue explains conditions for the evolution of the technology architecture, particularly through self-reinforcement. In general, the literature argues that a platform architecture can be characterized by its self-reinforcement; the control is distributed across multiple actors, relying on positive and negative feedback loops for evolution (Henfridsson and Bygstad,

2013). Although some literature has explored the role of feedback loops in platform governance (Huber et al., 2017), we believe there are areas of opportunities for more targeted investigation into the conditions under which positive and negative feedback loops influence resource distribution. For example, when operating on the boundary between flexibility and stability, the feedback loops should drive the dialectical relationship between the two – that is, the iteration or tuning, as referred by Eaton et al. (2015), between relaxing and tightening resource access. However, we encourage future studies to explore under what conditions the positive feedback loop overperforms the negative feedback loop, and vice versa.

Third, regarding cooperativity, this research avenue explains conditions for forming a healthy relationship between actors for value co-creation. With digital well-being gaining growing attention as a societal goal, future research should further explore the conditions under which positive and negative relationships between actors, as well as between actors and technology artifacts, are pronounced. For example, partisan and opinion polarization has been a major concern for social media platforms (Sun et al., 2023). Similarly, excessive use of applications has been a critical issue for mobile operating platforms (Domoff et al., 2019). Thus, studying how to mitigate the side effects of integrating resources from heterogeneous actors and retain healthy conditions in a platform context becomes worthy of more in-depth studies. In particular, can advanced technology (e.g., artificial intelligence) play a role in detecting, preventing, and correcting negative relationships? Answers to these questions could provide useful insights for the literature and offer valuable implications for operators and other platform-related actors.

8. Discussion

We have argued that the concept of platforms should better account for the variations observed in the widespread and growing literature in IS research. The dominant perspectives that merely distinguish between economic networks and architectural design are limiting and tend to downplay the richness of platform-related phenomena, as well as the differences and nuances in the IS literature. Grounded in S-D logic, we have reconceptualized platforms to transcend the limitations of a dichotomous approach,

thereby advancing the understanding that the concept of platforms revolves around an important multifaceted IS capability.

Building on our reconceptualization and the rich insights it entails, our paper makes several important contributions to the comprehension of platforms and extends beyond. First, we establish the boundary condition for platforms as an IS capability, providing a promising foundation for theory development on platforms in IS research. Specifically, we offer a foundation that enables a novel understanding of platforms. This understanding enables a discernible juxtaposition with the prevailing perspectives on economic networks and architecture design for better IS theorizing (de Reuver et al., 2018; Tiwana et al., 2010). By directing our attention towards platforms as a multifaceted IS capability for value co-creation, we engage in theoretical exploration of three interconnected facets. The first and third facets center around relationality in forming an actor network and cooperativity in forming resource integration, respectively. They contribute to the literature on the pursuit of network effects (Li et al., 2019; Song et al., 2018; Zhu et al., 2021). The second facet, which involves ambidexterity in forming resource distribution, complements the literature on architectural design and the pursuit of generativity (Sun et al., 2021; Tilson et al., 2010; Yoo, 2013). Thus, we seamlessly synthesize previously siloed perspectives of platforms into a more cohesive theoretical framework. Importantly, this synthesized theoretical framework allows researchers to examine prominent platform-related phenomena in a more systematic way, as suggested by the five research avenues that we have proposed.

Second, by discussing the significant role of relationality, ambidexterity, and cooperativity in the formation of platforms, our paper contribute to the advancement of S-D logic in IS research (Hein et al., 2020; Lusch and Nambisan, 2015). In doing so, we establish a closer link between IS research and the service literature. Specifically, our reconceptualization extends research on the vital role of technology in facilitating individuals and collectives in realizing value co-creation through service, which involves transformation of knowledge into value among heterogeneous groups of actors (Vargo and Lusch, 2004). Furthermore, our newly developed S-D Platform Framework offers a nuanced approach to studying service innovation by contextualizing actors' efforts in value co-creation, specifically mediated by a general-purpose technology. For example, by leveraging the framework we

have proposed and embracing the research avenues we have outlined, researchers can theorize about the mutual dependency, such as vicious and virtuous cycles, as well as the interactions between human and technology capitals, that service encompasses in shaping platform evolution (Tiwana et al., 2010). Thus, our paper extends the expanded perspective on digital-enabled service innovation (Lusch and Nambisan, 2015) by revealing its deep structure in a platform context.

Finally, the insights presented in our paper are highly relevant to practitioners, particularly for firms aiming to develop and implement strategies empowered by platforms. In this regard, we offer theoretical understanding of the anticipated outcomes resulting from platforms, such as network effects and generativity, as emphasized in much of the literature (Anderson Jr. et al., 2014; Eaton et al., 2015; Sun et al., 2021; Zhu et al., 2021). In addition, our framework also highlights novel ways to strategize around platforms as it uncovers detailed building blocks through which network effects and generativity can be achieved. These building blocks include collaborating socio-material perceptions, coordinating flexibility and stability in the architecture, and cooperating in value provision among different actors. Technology plays a central role in the formation and functioning of such service dominant strategizing (Barrett et al., 2015). Thus, our study offers an intriguing perspective for firms, especially during periods when they are reevaluating their existing product-dominant approaches and exploring new service-centric strategies. Our perspective involves embracing value co-creation across their entire business landscape, offering a transformative opportunity for organizational growth and adaptation in the digital age (Ross et al., 2017).

Our study is not without limitations. First, our conceptualization does not explicitly account for the causal directions between and within the three facets of platforms. While the concept of platforms is defined by the coexistence of all three facets, it can be assumed that the three facets collectively form the conceptual foundation for a more comprehensive theory of platforms. Although causalities and correlations were not the focus of our study, we encourage future research to investigate and examine casual relationships among platform-related phenomena, as suggested by the research agenda we have developed. Second, a limitation inherent in conceptual studies is the challenge of presenting the abstraction with practical examples across various contexts within a limited space. Readers can use our

framework as a stepping-stone to further explore additional characteristics of platforms in specific contexts.

9. Conclusion

The concept of platforms is prevalent in IS research. However, the omnipresence of platforms in the literature risks hindering the development of a consolidated theory of platforms, as a fluid understanding undermines the depth and nuances of the concept. Grounded in S-D logic, we have conducted an interpretive literature review to reconceptualize platforms, advancing platforms as a unique IS capability for value co-creation. In doing so, we have developed a new S-D Platform Framework to synthesize our findings. This framework encompasses 11 dimensions as well as three higher-level facets that we have abstracted from the literature – namely relationality, ambidexterity and cooperativity. Our reconceptualization emphasizes the importance of previously under-theorized deep structures that constitute the concept of platforms in IS research. Building on this new framework, we have proposed five broad avenues for future research, along with specific guiding research questions, to complement platform theorizing. We anticipate that our study will inspire researchers to strengthen and advance our understanding of platforms in a more consolidated manner. Such understanding is essential in assisting decision-makers in developing platform strategies, in addition to supporting architects and other practitioners in designing technology architectures that can optimize the effectiveness and efficiency of value co-creation.

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Appendices

Appendix A. Definitions of Platforms in the Literature

Table A1

The Platform Construct in the Information Systems Literature

Stream 1: Multi-sided market
"A platform is defined as a delivery system that enables value-added services to reach a consumer." (Oh et al., 2015, p. 245)
"the notion of platforms were initially introduced as 'two-sided markets', which refers to a market with two distinct sides that benefit from network effects by interacting on a common platform." (Tan et al., 2015, p. 250)
"we consider HIE [health information exchange] as a multisided platform in which the potential value of HIE for each practice depends on the other practices with which it shares patients." (Yaraghi et al., 2015, p. 2)
"Online outsourcing platforms (also known as 'online labor markets') are Internet-enabled systems that bring together service providers and buyers1 from around the world to contract information technology (IT) services, such as software development." (Hong & Pavlou, 2017, p. 547)
"platforms are two- or multi-sided markets… , they are characterized by distinct cross-side network effects, since each side derives positive externalities from the participation of the respective other group." (Wessel et al., 2017, pp. 344-345)
"Like other digital platforms, crowdfunding platforms operate as two-sided markets, meaning that each side of the market derives externalities from the participation of the respective other group." (Thies et al., 2018, p. 1240)
"we define mobile phone platforms as software-based systems that provide functionality to support the development of mobile applications and transactions among multiple sets of actors." (Ye & Kankanhalli, 2018, p. 166)

"sharing platforms are accessibility-based systems that provide mediating services enabling sharing transactions between lenders and borrowers and can charge platform fees to both groups." (Zimmermann et al., 2018, p. 672)
"In this type of [two-sided] market, an intermediary termed a 'platform' enables these groups of users to interact and transact business and provides everything that users require, such as hardware, software, after-sales support, and even protocols." (Jung et al., 2019, p. 1037)
"A digital platform (DP) is a technological entity that enables value creation by facilitating direct interactions between two or more groups of users." (Leong et al., 2019, p. 1531)
"[A] platform serves as an intermediary, providing the infrastructure and rules to bring together the two distinct user groups in the network, and facilitate transactions between them." (Li et al., 2019)
"platforms that facilitate the transactions between two or more constituent sides in large and complex networks of suppliers, intermediaries, and customers." (Tan et al., 2019, p. 583)
"Business-to-Business (B2B) e-commerce platforms are a virtual and technology-enabled meeting spaces in which multiple buyers and suppliers are able to interact and transact without the need for physical or even synchronous contact." (Najmul Islam et al., 2020, p. 1)
"All platforms exhibit two-sidedness in that they facilitate matching and transactions between consumers and service providers in their markets…" (Zhu et al., 2021, p. 1009)
Stream 2: Modular architecture
"A software platform is a software package that enables the realization of application systems." (Taudes et al., 2000, p. 227)
"the extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate." (Tiwana et al., 2010, p. 675)*
"platforms are defined as the set of components used in common across a product family whose functionality can be extended by applications" (Ceccagnoli et al., 2012, p. 263)

"A platform is defined as 'a set of stable components that supports variety and evolvability in a system by constraining the linkages among the other components'." (Ondrus et al., 2015, p. 260)
"A platform is a building block that provides an essential function to a technological system and serves as a foundation upon which complementary products, technologies, or services can be developed." (Spagnoletti et al., 2015, p. 364)
"A platform is a 'layered architecture of digital technology', combined with a governance model." (Parker et al., 2017, p. 256)
"they [platforms] are also technology infrastructures whose features shape the development of third-party complementary products." (Cennamo et al., 2018, p. 461).
"An open digital platform (ODP) can thus be defined as an extensible digital core that is opened for third parties to contribute improvements or add complements." (Karhu et al., 2018, p. 479)
"Digital platforms are layered modular technology architectures in business networks." (Kazan et al., 2018, p. 186)
"platforms, which comprise 'products, services, or technologies that act as a foundation upon which external innovators, organized as a business ecosystem, can develop their own complementary products, technologies, or services'." (Rolland et al., 2018, p. 419).
"Software platforms, such as operating systems and web browsers, are extensible codebases of software systems that provide core functionalities for the applications that run on them." (Song et al., 2018, p. 121)
[A platform is] "generic term for standard system architecture, communication protocol, or any fundamental, shared knowledge." (de Lima Fontão et al., 2019, p. 145)

Note: * This definition was used by several articles (e.g., Benlian et al., 2015; Qiu et al., 2017; Tiwana, 2018). We exclude the others to avoid redundancy.

Appendix B. Literature Coding

Appendix B shows our literature coding process. The Figures (B1-B3) show data structures of coding, with illustrative 1st order concepts extracted from the literature[8]. The Tables (B1-B3) show a comprehensive classification of the literature as supplementary.

[8] We do not exhaust 1st order concepts due to space limitation, but we present supplementary information in the tables below.

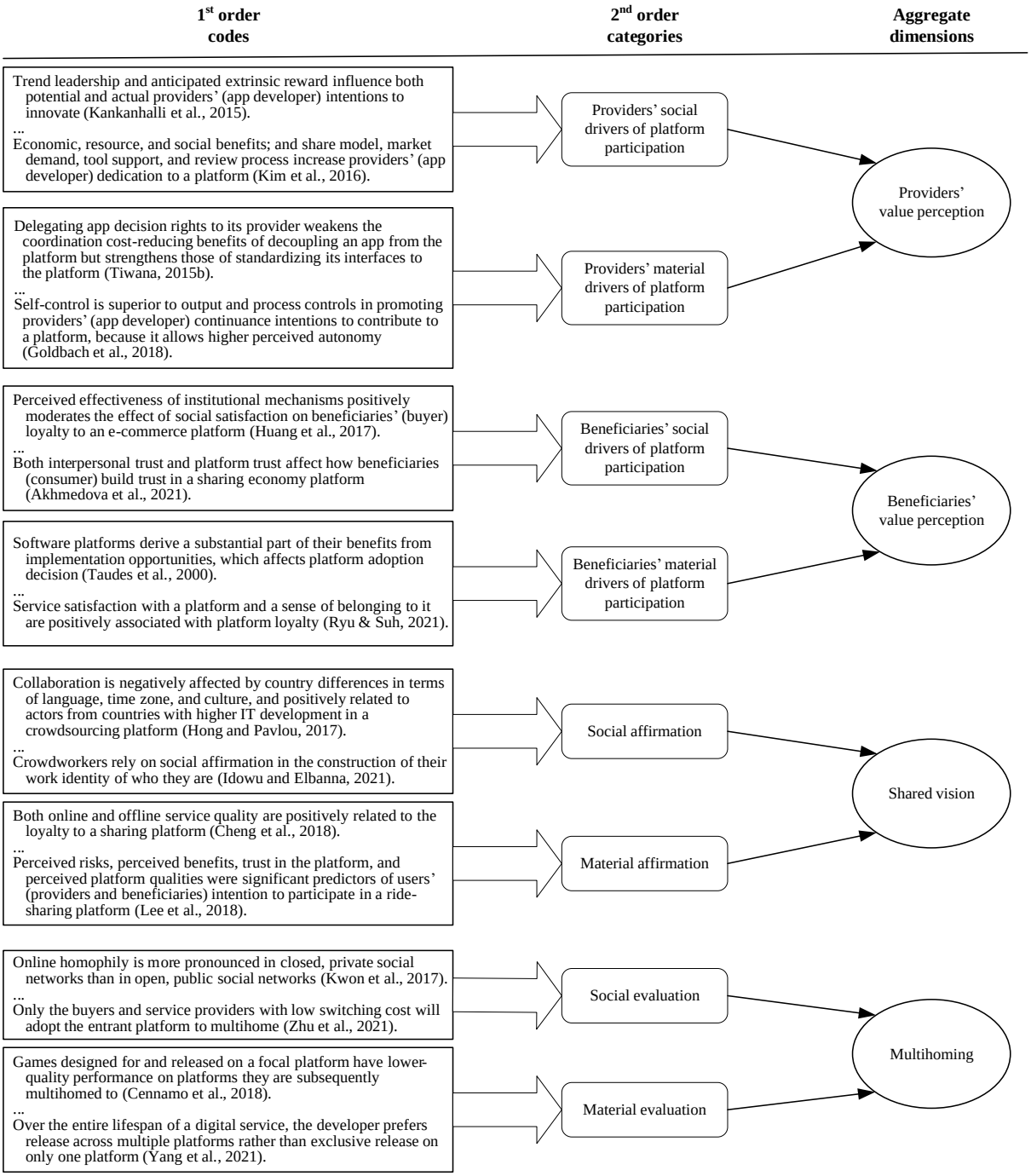

Figure B1

Data Structure (Actor-to-Actor Network)

Table B1

Classification of the Literature (Actor-to-Actor Network)

Source	Antecedents	Effect	Key Findings
Providers' Value Perceptions			

Source	Antecedents	Effect	Key Findings
(Benlian et al., 2015)	Perceived platform openness (PPO)	Continuous intention to contribute to mobile platforms	PPO is a multi-dimensional construct technology and distribution transparency and accessibility. PPO is positively associated with providers' perceived usefulness and satisfaction of a platform, which strengthens the intention to contribute.
(Kankanhalli et al., 2015)	Trend leadership Expected benefit Toolkit support	Potential and actual intention to innovate on mobile platforms	Trend leadership and anticipated extrinsic reward influence both potential and actual providers' intentions to innovate. Anticipated recognition and toolkit support affect only actual providers, while anticipated enjoyment affects only potential providers.
(Tiwana, 2015a)	App architecture App decision right Coordination cost	Discontinues contributing to a web browser platform	Delegating app decision rights to its provider weakens the coordination cost-reducing benefits of decoupling an app from the platform but strengthens those of standardizing its interfaces to the platform.
(Kim et al., 2016)	Relationship benefit Relationship-specific investments	Continuous intention to contribute to mobile platforms	Economic, resource, and social benefits, share model, market demand, tool support, and review process increase providers' dedication to a platform. Providers perceive higher termination costs, if the extent of learning and setup activity performed on a platform is substantial.
(Goldbach et al., 2018)	Control mode, i.e., output, process, and self-control	Continuous intention to contribute to	Self-control is superior to output and process controls in promoting providers' continuance

Source	Antecedents	Effect	Key Findings
		mobile platforms	intentions to contribute to a platform, because it allows higher perceived autonomy.
(Jiang et al., 2018)	Predecessors' actions when choosing a peer-to-peer (P2P) platform	Investors' decision to choose an online P2P platform	Herding exists when investor making decision to join a P2P platform. Investors' herding behavior is accentuated by platforms' market share and the cumulative amount funded, but attenuated by time in operation and government regulartoy events.
(Hong et al., 2020)	Perceived flexibility and security in the job market Information transparency	Willingness to participant in a ride-hailing platform	The utility and willingness of providers (drivers) to work for ride-hailing platforms increase when the platform provides a minimum wage guarantee, a benefit plan, and information features that protect providers' privacy and allow them to screen for undesired passengers.
(Liang et al., 2021)	Sacrifice reduction, i.e., transaction cost	Intention to join a sharing platform	Transaction costs (negatively) and perceived benefits (positively) affect perceived value, which affects providers' intention to use a platform.
Beneficeries' Value Perceptions			
(Taudes et al., 2000)	Option value of flexibility	Enterprise resource planning (ERP) system adoption	Software platforms derive a substantial part of their benefits from implementation opportunities, which affects platform adoption decision.
(Thies et al., 2016)	Others' opinion, i.e., e-world of mouth	Decision to use a crowdfunding platform	Others' opinion has a significant yet susbstantially weaker predictive power than others' behavior.

Source	Antecedents	Effect	Key Findings
	Others' behavior, i.e., popularity information		Whereas others' behavior has a more immediate effect on consumers' funding behavior, its effectiveness decays quickly.
(Huang et al., 2017)	Social capital Satisfaction Perceived effectiveness of institutional mechanisms	Loyalty to an e-commerce platform	Buyers' evaluation of social capital with the community of sellers can enhance their satis-faction with the sellers, which subsequently affect their loyalty to the platform. Perceived effectiveness of institutional mechanisms negatively moderates the effect of economic satisfaction and positively moderates the effect of social satisfaction on buyers' loyalty to the platform.
(Wright et al., 2017)	Technology Organization Environment	ERP system adoption	Organizational factors and environmental factors affect the degree to which nonprofit orgnanizations assimilate enterprise systems.
(Shim et al., 2018)	Network effect, new platform benefit and risk Organization Environment	ERP system adoption	New platform risk and organizational learning drives herding in the earlier stage of platform diffusion. New platform benefits and competitive pressure drives herding in the later stage of diffusion.
(Akhmedova et al., 2021)	Platform structural assurance Trust towards peers Perceived usefulness of the platform	Loyalty to a sharing platform	Both interpersonal trust (i.e., trust towards peer service provder) and platform trust (i.e., structural assurance and perceived usefulness) affect how consumers build trust in a sharing economy platform.

Source	Antecedents	Effect	Key Findings
(Lu et al., 2021)	Perceived effectiveness of platform and institutional structures (PEPIS, PESEIM)	Continuous intention to use a sharing platform	PEPIS has a positive impact on trust in the platform, which leads to continuous use intention. PESEIM negatively moderates the relationship between PEPIS and trust in the platform and the relationship between trust in the platform and continuous use intention.
(Ryu and Suh, 2021)	Self-image congruence Service satisfaction Sense of belonging	Loyalty to a crowdfunding platform	Service satisfaction with a platform and a sense of belonging to it are positively associated with platform loyalty. Self-image congruence is positively associated with service satisfaction and a sense of belonging, while the experience of greater campaign success moderates the relationship.
Shared View Between Providers and Beneficaires			
(Yaraghi et al., 2015)	Stronger externalities Learning from experience and peers	Adoption, usage, and practice on a healthcare platform	Adoption, use, and service coproduction behaviors are influenced by the topographies of both patients (beneficaries) and practitoners (providers) networks.
(Hong and Pavlou, 2017)	Country differences Provider reputation	Beneficiaries' (buyer) selection over providers on a crowdsourcing platform	Buyers are negatively affected by country differences in terms of language, time zone, and culture, and prefer service providers from countries with higher IT development. The reputation of service providers attenuates the negative effects of language and cultural (but not time zone) differences, while it substitutes

Source	Antecedents	Effect	Key Findings
			the positive effect of the country's IT development.
(Cheng et al., 2018)	Online and offline service quality Satisfaction	User (provider & beneficiaries) loyalty to a sharing platform	Both online and offline service quality are positively related to the loyalty to a sharing platform. The relationship is moderated by the pre-existent attitude towards the platform.
(Lee et al., 2018)	Perceived platform quality Trust in the platform Perceived risks Perceived benefits	User (provider & beneficiaries) loyalty to a ride-hailing platform	Perceived risks, perceived benefits, trust in the platform, and perceived platform qualities were significant predictors of users' intention to participate in Uber.
(Idowu and Elbanna, 2021)	Digital identity Nature of work Social environment	Beneficiaries' (workers) relationship with providers (employers) on a crowdsourcing platform	Crowdworkers rely on social affirmation in the construction of their work identity of who they are that cuts across the boundaries between themselves, the digital work they do and their social environment.
Multihoming			
(Kwon et al., 2017)	Platform openness Symmetric vs. asymmetric social networks	Beneficiaries' preferences with respect to social media platform diversity, i.e.,	Online homophily is more pronounced in closed, private social networks than in open, public social networks. Users of asymmetric and symmetric platforms exhibit weak and strong homophily, respectively.

Source	Antecedents	Effect	Key Findings
		single- vs. multi-homing	Whereas users who adopt a single socical networking platform tend toward homophily, those who subscribe to multiple platforms confirm the idea that "opposites attract."
(Cennamo et al., 2018)	App (game) quality performance App designed for focal or multihomed platforms	Providers' multihoming decision for gaming platforms	Multihoming games have lower-quality performance on a technologically more complex console than on a less complex one. Games designed for and released on a focal platform have lower-quality performance on platforms they are subsequently multihomed to.
(Yang et al., 2021)	App pricing App releasing	Providers' multihoming decision for mobile platforms	Over the entire lifespan of a digital service, the developer prefers release across multiple platforms rather than exclusive release on only one platform.
(Zhu et al., 2021)	Transaction cost Platform interconnectivity	Providers' and beneficiaries' multihoming decision for mobile platforms	Only the buyers and service providers with low switching cost will adopt the entrant platform to multihome. Having more mobile buyers, which increases interconnectivity between markets, can reduce the incumbent's incentive to fight, which increases the entrant's incentive to expand.

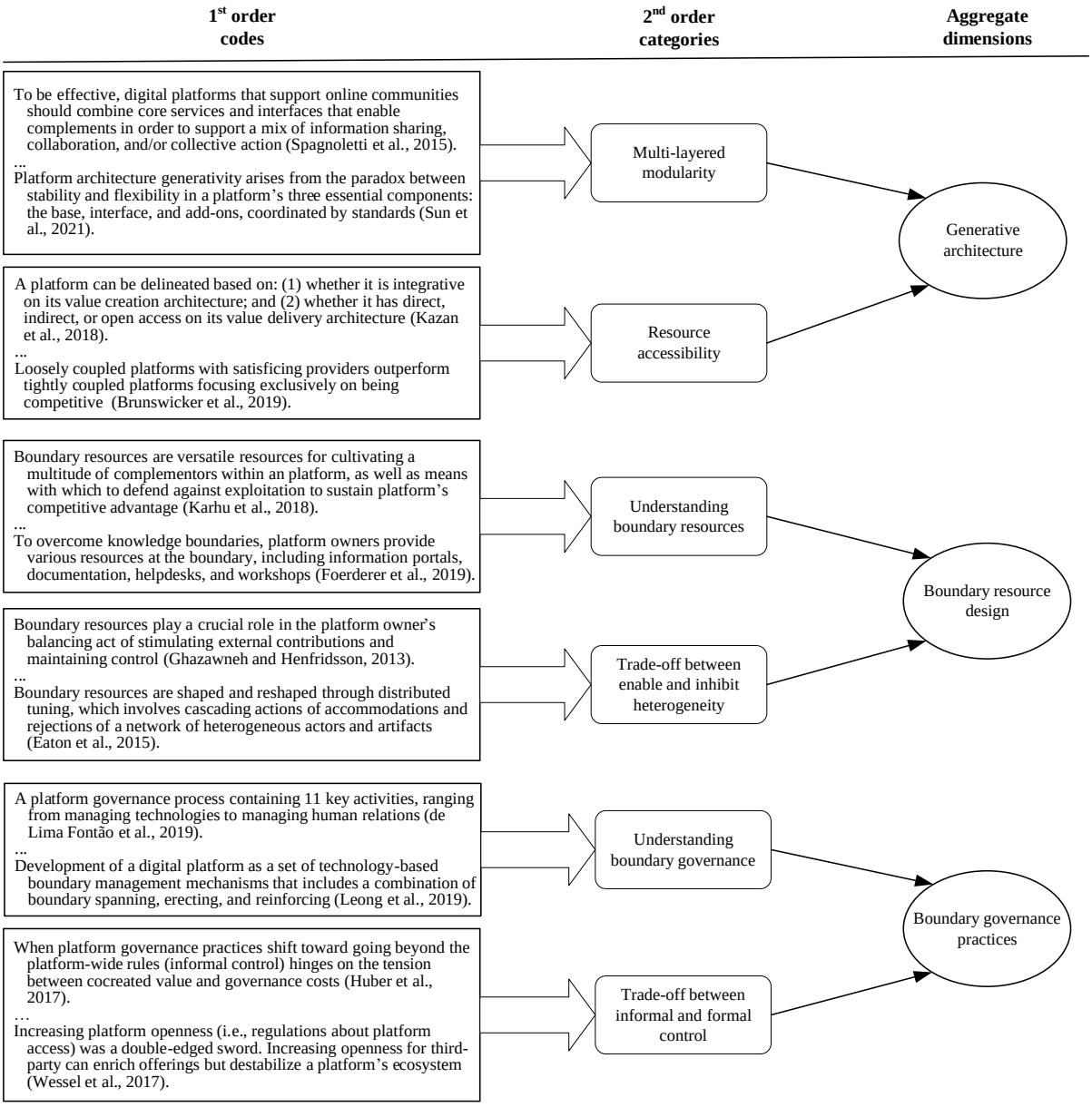

Figure B2

Data Structure (Resource Distribution)

Table B2

Classification of the Literature (Resource Distribution)

Source	Antecedents	Effect	Key Findings
Generative Architecture			

(Spagnoletti et al., 2015)	Platform components, i.e., core, interfaces, and complements	Architecture for online community platforms (OCP)	To be effective, an OCP should combine core services and interfaces that enable complements in order to support a mix of information sharing, collaboration, and/or collective action.
(Kazan et al., 2018)	Strategic dimensions of value creation and value delivery architectures	Profile of payment platform architecture	A (payment) platform can be delineated based on: (1) whether it is integrative on their value creation architecture; and (2) whether it has direct, indirect, or open access on its value delivery architecture.
(Brunswicker et al., 2019)	Providers' design strategy, i.e., being competitive, lower level of being competitiveness but other interests	Performance of decoupling for app development platforms	If moderate to tightly coupled platforms with optimizing producers focused exclusively on being competitive, platform performance is lower compared to platforms with satisficing producers who put a lower priority of being competitive because of other interests.
(Sun et al., 2021)	Paradox between stability and flexibility	Generativity in enterprise platform architecture	Platform architecture generativity arises from the paradox between stability and flexibility in a platform's three essentail components: the base, interface, and add-ons, coordinated by standards.
Boundary Resource Design			
(Ghazawneh and Henfridsson, 2013)	Resourcing, i.e., process by which diversity is enhanced	Boundary resources design and use for a mobile platform	Boundary resources play a crucial role in the platform owner's balancing act of stimulating external contributions and maintaining control. Four specialized constructs for understanding the actions taken in third-party development: self-

	Securing, process by which control is increased		resourcing, regulation-based securing, diversity resourcing and sovereignty securing.
(Eaton et al., 2015)	Digital tuning, i.e., a web of actions and reactions over time among technology and social actors	Boundary resource design for a mobile platform	Boundary resources are shaped and reshaped through distributed tuning, which involves cascading actions of accommodations and rejections of a network of heterogeneous actors and artifacts.
(Karhu et al., 2018)	Platform forking, i.e., bypassing boundary resource to the core	Boundary resource design for a mobile platform	Boundary resources are versatile resources for cultivating a multitude of complememtors within an platform, as well as means with which to defend against exploitation to sustain platform's competive advantage.
(Foerderer et al., 2019)	Trade-off between providing knowledge at the right scope and allowing for scalability of knowledge	(Knowledge) Boundary resources for enterprise platforms	Knowledge boundaries are influenced by a platform's functional extent, interface design, and evolutionary dynamics. To overcome knowledge boundaries, platform owners provide various resources at the boundary, including information portals, documentation, helpdesks, and workshops.
Boundary Governance Practices			
(Nielsen and Aanestad, 2006)	Control at different levels, i.e., providers and operators	Infrastructure governance for mobile platforms	Platform control devolution as a design approach should be based on a deep understanding of the existing control/autonomy balance as well as the distribution of resources, risks and the ability and willingness to innovate.
(Grøtnes, 2009)	Level of standardization,	Governance practices (open	The case lead by established firms in the industry has a process where radical innovations are

	i.e., established and "newcomers"	innovation) for mobile platforms	introduced early in the process, while the case lead by newcomers has a process where radical innovations are introduced late in the process.
(Huber et al., 2017)	Tension between co-created value and governance costs	Governance practices for enterprise platforms	How ecosystem-wide rules and values are practiced considerably varies and changes over time. Initially, governance practices follow ecosystem-wide rules; if practices shift toward going beyond the rules hinges on the tension between co-created value and governance costs.
(Wessel et al., 2017)	Platform openness, i.e., deliberate regulations about platform access	Governance practices (input control) for a crowdfunding platform	Increasing platform openness was a double-edged sword for a platform ecosystem. Increasing platform openness for third-party offerings can destabilize a platform's ecosystem.
(de Lima Fontão et al., 2019)	Content reuse repositories, i.e., app store and material support portal	Governance practices (general) for mobile platforms	A platform governance process containing 11 key activities, ranging from managing technologies (e.g., provide app repository) to managing human relations (e.g., create and evolve a developer relations team).
(Leong et al., 2019)	Complex network of interactions between actors	Governance practices (boundary management) for a ticketing platform	Development of a digital platform as a set of technology-based boundary management mechanisms that includes a combination of boundary spanning, erecting, and reinforcing, empowered by network dynamics.
(Floetgen et al., 2021)	Five platform architypes, i.e., diversification, business model	Mobile platform resilience	A combined and multilevel view of organisational and community resilience is needed in the context of platform ecosystems.

	adaptation, serving public goods, creating meta base, and optimizing operation		Platform owners can efficiently facilitate access to not connected actors as they design, facilitate and alter modular architecture and governance.

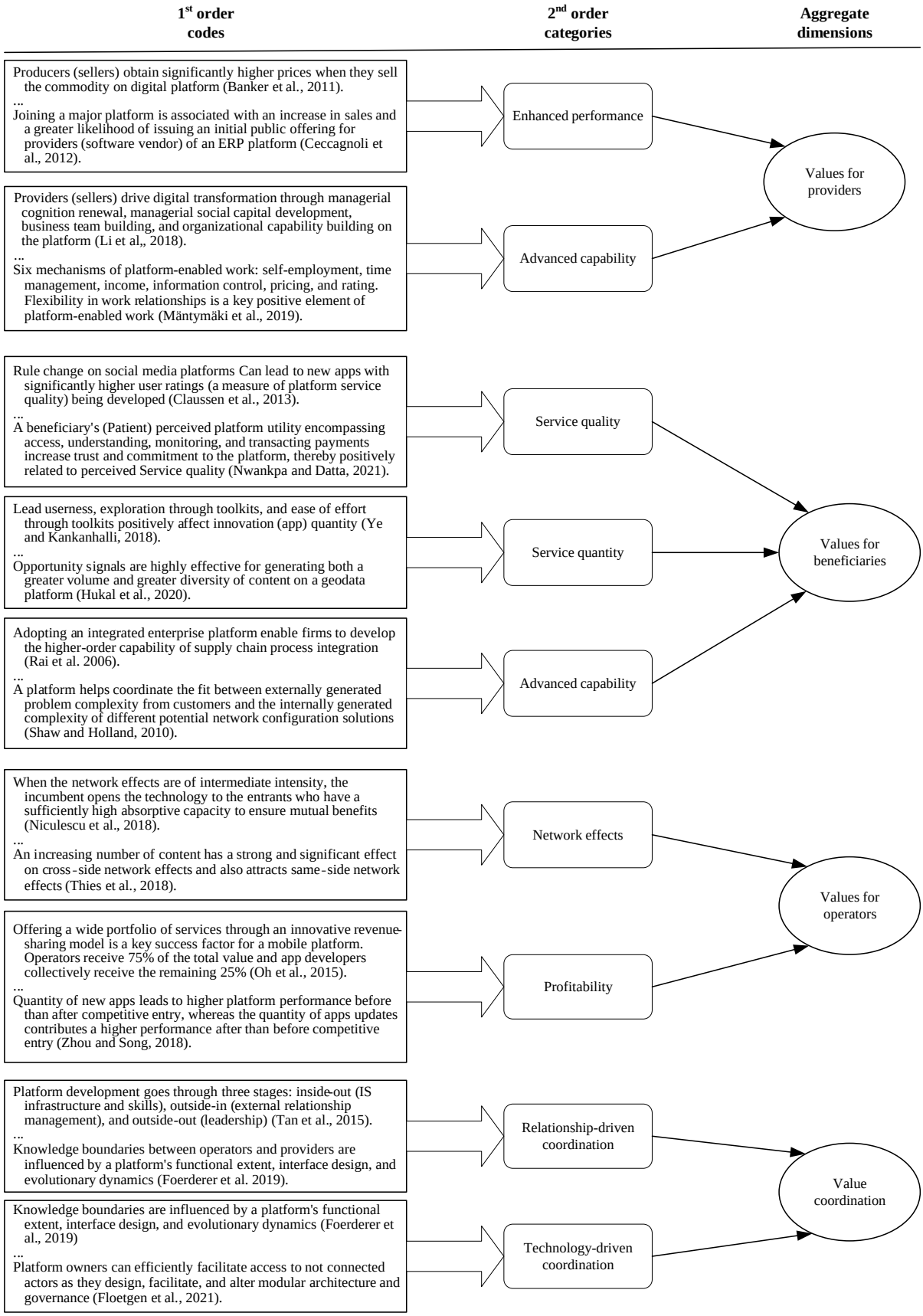
1st order codes
2nd order categories
Aggregate dimensions
Producers (sellers) obtain significantly higher prices when they sell the commodity on digital platform (Banker et al., 2011).
...
Joining a major platform is associated with an increase in sales and a greater likelihood of issuing an initial public offering for providers (software vendor) of an ERP platform (Ceccagnoli et al., 2012).
Providers (sellers) drive digital transformation through managerial cognition renewal, managerial social capital development, business team building, and organizational capability building on the platform (Li et al,, 2018).
...
Six mechanisms of platform-enabled work: self-employment, time management, income, information control, pricing, and rating. Flexibility in work relationships is a key positive element of platform-enabled work (Mäntymäki et al., 2019).
Enhanced performance
Advanced capability
Values for providers
Rule change on social media platforms Can lead to new apps with significantly higher user ratings (a measure of platform service quality) being developed (Claussen et al., 2013).
...
A beneficiary's (Patient) perceived platform utility encompassing access, understanding, monitoring, and transacting payments increase trust and commitment to the platform, thereby positively related to perceived Service quality (Nwankpa and Datta, 2021).
Lead userness, exploration through toolkits, and ease of effort through toolkits positively affect innovation (app) quantity (Ye and Kankanhalli, 2018).
...
Opportunity signals are highly effective for generating both a greater volume and greater diversity of content on a geodata platform (Hukal et al., 2020).
Adopting an integrated enterprise platform enable firms to develop the higher-order capability of supply chain process integration (Rai et al. 2006).
...
A platform helps coordinate the fit between externally generated problem complexity from customers and the internally generated complexity of different potential network configuration solutions (Shaw and Holland, 2010).
Service quality
Service quantity
Advanced capability
Values for beneficiaries
When the network effects are of intermediate intensity, the incumbent opens the technology to the entrants who have a sufficiently high absorptive capacity to ensure mutual benefits (Niculescu et al., 2018).
...
An increasing number of content has a strong and significant effect on cross-side network effects and also attracts same-side network effects (Thies et al., 2018).
Offering a wide portfolio of services through an innovative revenue-sharing model is a key success factor for a mobile platform. Operators receive 75% of the total value and app developers collectively receive the remaining 25% (Oh et al., 2015).
...
Quantity of new apps leads to higher platform performance before than after competitive entry, whereas the quantity of apps updates contributes a higher performance after than before competitive entry (Zhou and Song, 2018).
Network effects
Profitability
Values for operators
Platform development goes through three stages: inside-out (IS infrastructure and skills), outside-in (external relationship management), and outside-out (leadership) (Tan et al., 2015).
...
Knowledge boundaries between operators and providers are influenced by a platform's functional extent, interface design, and evolutionary dynamics (Foerderer et al. 2019).
Knowledge boundaries are influenced by a platform's functional extent, interface design, and evolutionary dynamics (Foerderer et al., 2019)
...
Platform owners can efficiently facilitate access to not connected actors as they design, facilitate, and alter modular architecture and governance (Floetgen et al., 2021).
Relationship-driven coordination
Technology-driven coordination
Value coordination

Figure B3

Data Structure (Resource Integration)

Table B3

Classification of the Literature (Resource Integration)

Source	Antecedents	Effect	Key Findings
Values for Providers			
(Banker et al., 2011)	Participating in an agriculture e-commerce platform	Business performance, i.e., commodity pricing	Producers obtain significantly higher prices when they sell commodities on a platform. Commodities with higher price volatility and require face-to-face interactions to verify quality obtain lower prices on the platform.
(Ceccagnoli et al., 2012)	Participating in an enterprise platform	Business performance, i.e., sales and likelihood of initial public offering	Joining a major platform is associated with an increase in sales and a greater likelihood of issuing an initial public offering. The impacts are greater when indepdendent software vendors have greater intellectual property rights or stronger downstream capabilities.
(Qiu et al., 2017)	Participating in a mobile platform with the logic of profession and markets	Working capabilities	Third party app developers' identities and practices depend on the two field-level logics as well as their interactions with the platform operator for better app ideation, executation, and marketing capabilities.
(Li et al., 2018)	Participating in an e-commerce platform	Working capacities	Small-to-medium entrepreneurs drive digital transformation through managerial cognition renewal, managerial social capital development, business team building, and organizational capability building on the platform.

(Tiwana, 2018)	Participating in a mobile platform	Business performance, i.e., competitive lead	Combining modularity in an app's external architecture with monolithicity in its internal architecture propels it ahead of rival apps because it enhances its platform synergy by better leveraging the platform's capabilities.
(Li et al., 2019)	Functions on e-commerce platforms	Business performance, i.e., sales	A seller could improve sales performance by using platform functions. The performance impact of this repertoire approach to function use varies depending on seller reputation, manifested as customer rating.
(Mäntymäki et al., 2019)	Participating in a ride-hailing platform	Working capabilities	The study identifies six mechanisms of platform-enabled work: self-employment, time management, income, information control, pricing, and rating. Flexibility in work relationships is a key positive element of platform-enabled work.
(Ye and Kankanhalli, 2020)	App innovativeness, i.e., novelty (number of changes) and intensity (number of versions) on a mobile platform	Business performance, i.e., revenue	Novelty shows a curvilinear relationship with mobile app performance whereas intensity shows a positive linear relationship. Customer participation positively impacts mobile app performance and positively moderates the effects of intensity and novelty.
Values for Beneficiaries			
(Rai et al., 2006b)	Enterprise platform integration, i.e., data consistency and cross-	Firm capabilities, i.e., operational excellence, customer	Adopting an integrated enterprise platform enable firms to develop the higher-order capability of supply chain process integration.

	functional app integration	relationship, and revenue	Platform integration capability results in sustained firm performance gains, especially in operational excellence and revenue growth.
(Shaw and Holland, 2010)	Implementation of an electronic market platform	Firm capabilities, i.e., language translation	A platform helps coordinate the fit between externally generated problem complexity from customers and internally generated complexity of different potential network configuration solutions.
(Claussen et al., 2013)	Rule change on a social media platform	Service quality, i.e., rating and number of active users	Rule change leads to new apps with significantly higher user ratings being developed. Sheer network size becomes less important driver for app success, update frequency benefits apps more in staying successful, and active users of apps decline less rapidly with age.
(Tiwana, 2015b)	Extension (app) modularization Input control over extension	Service quality, i.e., number of daily active user and ratings	The complementarity between input control and a platform extension's modularization—via inducing evolution—influences its performance on a web brower platform.
(Sedera et al., 2016)	Implementation of enterprise platforms	Firm capabilities, i.e., innovativeness	Enterprise platform has a significant and positive impact on innovation. Enterprise platform quality has a moderating effect on innovation.
(Rolland et al., 2018)	Enterprise platform options, i.e., opportunity to invest in new features and debt, i.e., buildup of	Firm capabilities and practices	While firms need to resolve digital debt to make a platform's digital options actionable, hesitancy to plant digital debt may equally prevent them from realizing attractive digital options. While identified digital options may offer organizations new opportunities to resolve

	obligations related to maintenance that represent risks		digital debt, eagerness to realize digital options may lead to unwise planting of digital debt.
(Ye and Kankanhalli, 2018)	Design autonomy Toolkit support Lead sureness	Service quantity, i.e., number of apps	Lead userness, exploration through toolkits, and ease of effort through toolkits positively affect innovation quantity. Decision-making autonomy and work-method autonomy influence innovation quantity, but scheduling autonomy does not.
(Hukal et al., 2020)	Two operating strategies, i.e., opportunity signal and endorsement signal	Content quantity, i.e., volume and diversity	Opportunity signals are highly effective for generating both a greater volume and greater diversity of content on the platform. Endorsement signals positively affect content volume, but do not lead to content diverisity.
(Najmul Islam et al., 2020)	Platform function, i.e., information search, ownership, retirement etc.	Firm capabilities, i.e., purchasing service assimilation	The importance of information search decreases, whereas the importance of ownership and retirement functionalities increases, as a firm moves from the awareness stage to the general deployment stage of service assimilation.
(Masiero and Arvidsson, 2021)	Socio-tech design of an e-commerce platform in rural areas	(Negative) Social effects	The platform produced degenerative effects in three layers: access (the front-end where social protection recipients access goods), monitoring (the back-end monitoring of the social protection system), and policy (the agenda on which social protection is based).
(Nwankpa and Datta, 2021)	Utility of a mobile payment platform in healthcare	Service quality, i.e., perceived healthcare	A patient's perceived platform utility encompassing access, understanding, monitoring, and transacting payments increase

		service quality (HSQ)	trust and commitment to the platform, thereby positively related to perceived HSQ.
(Xu, 2021)	Textual layout design of on-demand food service platforms, comments, costs, and listed merchants	Service quality, i.e., satisfaction with main provider (restaurant)	The performances of drivers and the platform affects customers' overall satisfaction with restaurants. A higher order cost makes customers comment more on the attributes offered by the restaurants to show their overall satisfaction.
Value for Operator			
(Bakos and Katsamakas, 2008)	Design strategies, i.e., investment in each side	(E-commerce) Platform network effects	The network design is highly asymmetric as the intermediary will focus its investment and pricing on extracting surplus from one side, after making enough investment to ensure the participation of the other side.
(Anderson Jr. et al., 2014)	Investment strategies, i.e., investing in high performance vs. facilitate third party contribution	(Game console) Platform network effects	Heavily investing in the core performance of a platform does not always yield a competitive edge. Sometimes, offering a platform with lower performance but greater availability of content can be a winning strategy for strong network externalities.
(Ondrus et al., 2015)	Strategy of openness at provider, technology, and user levels	Platform network effects	Opening the platform at all three levels (provider, technology, and user) to additional firms and users from the same and additioanl industry results in a greater (or at least equal) market potential for network effects.

(Oh et al., 2015)	Value appropriation between the operator and providers	(Mobile) Platform performance, i.e., profitability	Offering a wide portfolio of services through an innovative revenue-sharing model is one of key success factors in the mobile ecosystem. Operators receive 75% of the total value created and app developers collectively receive the remaining 25%.
(Parker et al., 2017)	Strategy of openness, i.e., allowing more developers to contribute to a platform	Platform network effects	Firms choose to innovate using open external contracts in preference to closed vertical integration. Firms that pursue high risk innovations with more developers can be more profitable than firms that pursue low risk innovations with fewer developers.
(Niculescu et al., 2018)	Strategic decision, i.e., open to allow same side co-opetition Absorptive capacity of the entrant	Platform network effects (general)	When an entrant chooses the quality level and an incumbent is strategic in its platform opening decision, intense network effects make new players shun the market. When the network effects are of intermediate intensity, the incumbent opens the technology to the entrants who have a sufficiently high absorptive capacity to ensure mutual benefits.
(Song et al., 2018)	Platform policies, i.e., app review time and platform update frequency	(Web browser) Platform cross-side network effects (CNE)	While the growth in platform usage results in long-term growth in both the number and variety of apps, the growth in the number of apps and the variety of apps only leads to short-term growth in platform usage. Long app review time weakens the long-term CNE of the user-side on the app-side, but not

			the short-term CNE of the app-side on the user-side; and frequent platform updates weaken the CNEs of both sides.
(Thies et al., 2018)	Number of providers (funders) and beneficiaries (entrepreneurs) Platform policies, i.e., input control	(Crowdfunding) Platform network effects	An increasing number of content has a strong and significant effect on botn cross-side and same-side network effects. An increased installed base of funders does not have an effect on the growth of either side of the market; and under weaker input control, both cross-side and same-side network effects are weaker.
(Zhou and Song, 2018)	Quality of apps Diversity of apps Competitive entry	(Mobile) Platform performance, i.e., market share	Quantity of new apps leads to higher platform performance before than after competitive entry, whereas the quantity of apps updates contributes a higher performance after than before competitive entry. The quality is more important and diversity is less important to performance after than before competitive entry.
(Wulf and Blohm, 2020)	Platform design with API archetypes, i.e., professional, mediation, and open asset services.	Platform performance, i.e., return on investment and diffusion	The interaction the three archetypes and the target level of economies of scope in production is positively related to platform return on investment and diffusion.
Value Provision			

(Tan et al., 2015)	Information system (IS) capabilities	(E-commerce) Platform development	Platform development goes through three stages: inside-out (IS infrastructure and skills), outside-in (external relationship management), and outside-out (leadership).
(Hann et al., 2016)	Migration from older to newer generations In-direct network effect in same generation Effect of adoption	Mobile platform backward capability	Whereas an intergenerational service may accelerate the migration to the subsequent platform generations, it may also provide a fresh lease on life for earlier generation platforms due to the continued use of earlier generation services on newer platform generations.
(Foerderer et al., 2019)	Information portals, documentation, helpdesks, and alignment workshop Trade-off between scope and scalability	Address knowledge boundaries between operator and providers	Knowledge boundaries (broadcasting, brokering, and bridging) are influenced by a platform's functional extent, interface design, and evolutionary dynamics, which create differences, dependencies, and novelty of development knowledge, resulting in qualitatively distinct of knowledge boundaries.
(Saarikko et al., 2019)	Explorative and exploitative activities Strategic foresight and systemic insight patterns	(Enterprise) Platform establishment	Successful establishment of a platform depends on the operator’s ability to integrate business acumen with technical proficiency and leverage these combined skills to ensure short-term viability and long-term relevance in the market.
(Tan et al., 2019)	IT-enabled capabilities, i.e., localized,	(E-commerce) Platform	IT-enabled operational agility in complex organizational forms, cultivated through the development of resource-interdependent

	synergistic, and optimized	operational agility	capabilities to deliver effective sensing and response mechanisms, forms effective strategies for the platform in dynamic marketplace conditions.
(Alaimo et al., 2020)	Data types Technological functionality Actor configurations	Social media platform evolution	Platform evolves over three stages: search engine, social meida, and end-to-end service ecosystem. Services that develop as commercially viable and constantly updatable data bundles out of diverse and dynamic data types are essential to the making of the complementarities that are claimed to underlie ecosystem formation.
(Schreieck et al., 2021)	Technology capabilities Relationship-driven capabilities	Value co-creation and value capture	Five capabilities to enabled value co-creation on enterpise platforms: cloud-based platformization, open IT landscape management, ecosystem orchestration, platform evangelism, and platform co-selling.