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Building digital platform ecosystems: A synthetization of fundamental design topics from a literature review

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ABSTRACT

The purpose of this paper is to contribute to the existing body of research on digital platforms by adopting an ecosystem perspective and considering an established framework. Through our work, we synthesize previous findings related to digital platforms and provide new insights into their ecosystem design. To achieve this, we conducted a comprehensive literature review to identify and synthesize relevant findings. Using this framework, we conducted a qualitative content analysis that allowed us to derive design recommendations and aggregate related design themes from the reviewed publications. The results of our study reveal a detailed framework that includes various design topics tailored to different stakeholders within the platform ecosystem. In practical terms, our findings provide valuable guidance to practitioners to help them make informed design and resource allocation decisions in the context of complex transformation projects. The identified themes synthesize the activities necessary to develop a platform's ecosystem and can be viewed as a basic design framework. This framework can serve as a playbook for practitioners seeking to navigate digital transformation processes toward platform-based models. Given the critical role of platform design in both academic and practical domains, this study aims to synthesize existing research on digital platforms and offer a framework that considers possible design topics from a business ecosystem perspective. This contribution is particularly important given the growing importance of platform ecosystems in today's digital economy.

1. Introduction

Digitalization of the economy has engendered a proliferation of digital platforms (DPs) and intricate business ecosystems (BEs). In the current digital era, companies must leverage these DPs and BEs effectively to remain competitive and adeptly navigate the rapidly changing market conditions. The relevance of these concepts is rooted in their ability to support firms in generating and capturing value through amplified collaboration and co-creation with other organizations and stakeholders (Adner, 2017; Jacobides et al., 2018; Lusch & Nambisan, 2015; Wagner, 2021). The shift toward value-creating networks (Jacobides et al., 2018; Prockl et al., 2017; Stevens & Johnson, 2016), has persisted, resulting in co-creation processes – facilitated by advanced social technologies – that supplant traditional value chains with open knowledge- or skill-based networks. Multiple actors, including individuals, customers, partners, competitors, suppliers, and stakeholders partake in these networks to create value (Jacobides et al., 2018; Jonsson et al., 2021; Prockl et al., 2017; Stevens & Johnson,

2016). This trend has been noted by several authors (De Reuver et al., 2018; Felch & Sucky, 2022; Gawer & Cusumano, 2002; Jacobides et al., 2018).

Consequently, value creation has evolved into a more collaborative and open process (Adner & Kapoor, 2010). A novel perspective on value, value creation, and value extraction, taking into account multiple levels and actors, differentiates ecosystems from conventional value chains and transactional networks (Ben Letaifa, 2014; Vargo & Lusch, 2008). The shift toward BEs relocates value creation from a linear economic process in a specific supply and production chain to a more interconnected, open, and emergent process that involves multiple actors, including customers and competitors (Adner, 2017; Ben Letaifa, 2014). This process provides opportunities for cross-border and cross-industry collaboration (Porter & Heppelmann, 2014) and facilitates access to open resources for companies of all sizes (Felch & Sucky, 2022; Nambisan et al., 2017). The integration of resources between actors creates value for themselves and the ecosystem (Wieland & Durach, 2021). In the context of networked and interconnected communities, traditional

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silos within and outside organizations are no longer feasible (Ben Letaifa, 2014). Digitalization, DPs and data-driven services are paving the way for a paradigm shift in supply chain management (SCM), leading to more self-organizing and self-optimizing ecosystems (Alexander et al., 2022; Frederico et al., 2019; Jonsson et al., 2021; Pflaum et al., 2018; Prockl et al., 2017). To facilitate the development and delivery of value in today's complex ecosystems, future studies may explore design issues (Felch & Sucky, 2022; Fink et al., 2022; Goertler et al., 2023; Helfat & Raubitschek, 2018; Porter & Heppelmann, 2014). The effective utilization of these concepts is crucial for companies that seek to remain competitive in today's volatile, uncertain, and complex digital economy, and they must embrace innovative technologies and DPs and establish strategic partnerships and collaborations in order to succeed.

Therefore, the purpose of this study is to devise a framework that can aid both organizations and scholars in accurately characterizing the BE centered on a digital platform (DP). This framework functions as a tool for identifying the configuration of the ecosystem and its corresponding manifestations, while simultaneously reducing the intricacy of the design process. The research question (RQ) is as follows:

RQ: *What topics should be considered when designing the business ecosystem of a digital platform?*

In an effort to address the research inquiry, a systematic literature review (SLR) was performed (Cooper, 2017). The review was focused on 44 publications containing insights into DPs. These insights were then utilized to amalgamate related research findings and to create a framework that facilitates the design of a DP ecosystem. We structure the remainder of our paper as follows: Section 2 summarizes the conceptual background of our study. In the subsequent sections we present the methodology and summarize the results of our review. We conclude our paper with a discussion of the findings and ideas for further research.

2. Conceptual background

2.1. On supply chains and business ecosystems

Supply chains are understood in the classic definition of Mentzer et al. (2001, p. 4) as "a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, financial resources, and/or information from a source to a customer". In this context, supply chains were initially depicted as a series of process steps to transform raw materials into final products, with these steps increasingly being carried out by multiple suppliers over time (Legenvre et al., 2022). Thus, supply chain governance has gained strategic importance, whereby competition has been understood as rivalry between entire supply chains and not just between companies (Ketchen Jr. & Hult, 2007). More recently, network theory has added a mix of performance factors, such as reliability and flexibility, to the view of supply chains as networks (Goertler et al., 2024; Ketchen Jr. & Hult, 2007; Stevens & Johnson, 2016).

While SCM was originally described as the management of relationships with suppliers and customers, with the goal of achieving superior customer value at lower cost for the entire supply chain (Christopher, 1998, 2016), current views are moving away from a static view toward a concept that takes into account the volatility and complexity surrounding companies in today's business environment (Christopher & Holweg, 2017; Richey et al., 2022). The importance of information and communication technologies (ICTs) also has a strong impact on SCM (Choi et al., 2022; Ivanov et al., 2021; Pflaum et al., 2018). Digitalization of supply chains through ICTs enables information sharing, collaboration, and communication via DPs, which in turn leads to increased reliability, agility, flexibility, and effectiveness (Attaran, 2020; Khan et al., 2021). DPs play a critical role in this context (Pan et al., 2021), as they bring together all of the operational processes (e.g., procurement, production, logistics, or distribution), supply chain flows (e.g., physical, information, and financial), and supply chain actors (e.g.,

suppliers, producers, or customers) on the platform (Attaran, 2020; Ivanov et al., 2022). A BE approach is shown to be suitable for such a dynamic environment. Such an approach implies a community consisting of different levels of interconnected participants that are interdependent for their mutual effectiveness and survival and which thus share their fate (Jansiti & Levien, 2004). The goal of BEs is to collectively create value in ways that a single actor would not be able to (Adner, 2006). Therefore, a BE focuses on customer value created by combining complementary products and services (Felch & Sucky, 2022). Companies bundle their individual offerings into a coherent, customer-centric solution (Adner, 2006). The interaction of the different providers results in the total benefit (Burgin & Meissner, 2017; Ennen & Richter, 2010); in other words, the value of combining the products is higher than if the products were purchased individually (Nalebuff & Brandenburger, 1997). The increasing relevance of ecosystems may also be due to the ongoing digitization, the expansion of DPs, and the rapid development of advanced ICTs (Felch & Sucky, 2022; Gawer & Cusumano, 2002; Goertler et al., 2023; Jacobides et al., 2018). Consistent with Pflaum et al. (2018), we believe that DPs, in combination with data-driven services, pave the way for a paradigm shift in SCM, leading to more self-organizing and self-optimizing ecosystems, which is why the exact description of the ecosystem structure is necessary.

The ecosystem-as-structure approach developed by Adner (2017) serves as a perspective that explains the structure of interdependent value-creation activities (Adner, 2017) within dynamic environments. Using this conceptual framework, the alignment of activities, actors, positions, and connections within an ecosystem can be characterized (Adner, 2017). Thus, the focus of this perspective is on the value-creating activities, which fits our research objective. Therefore, we use the following definition of a BE: "The alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (Adner, 2017, S. 42). According to Adner's (2017) ecosystem-as-structure approach, four key elements of structure are vital to capturing the value proposition of a BE. The first element pertains to activities that outline the individual actions necessary for value creation (Adner, 2017). Actors, the second element, are the entities that perform activities, with a single actor being capable of performing multiple activities, and vice versa (Adner, 2017). Positions, the third element, denote where actors are situated in the activity flow and indicate who transfers to whom (Adner, 2017). Finally, links refer to transfers between actors, which are independent of the focal actor, meaning the actor from which the analysis is conducted, as specified by Adner (2017). The aforementioned four elements delineate the design for creating value in the interdependent collaboration of the BE that underlies a value proposition. This ecosystem-as-structure approach follows a specific order and starts with the value proposition, then considers the activities required to achieve it, and ends with the actors that need to be aligned (Adner, 2017). The approach explicitly extends the strategic perspective to activities and actors over which the focused organization may have no control and with which it has no direct contact, and it depicts the actors and activities that are essential in realizing the value proposition (Adner, 2017). Since this is inherently the case within SCM, Adner's (2017) framework was selected for this study.

2.2. Digital platforms

The flourishing of digitalization has rendered the availability of a significant volume of information and knowledge crucial to the success of businesses (Porter & Heppelmann, 2014; Van Alstyne et al., 2016). In order to thrive in the context of increasing volatility, uncertainty, and complexity, companies must be capable of exhibiting a high degree of adaptability. The ability to make informed, high-quality decisions in response to rapidly changing business units or technologies can be facilitated through the configuration of an appropriate BE (Adner, 2006, 2017; Adner & Kapoor, 2010; Ben Letaifa, 2014; Jacobides et al., 2018). This BE also mandates that companies adopt innovative technologies

and DPs for data collection, integration, and utilization, as well as pursuing opportunities for growth, in order to remain competitive (Subramanian et al., 2011).

Platforms are not a new concept and have been around for years (Rietveld & Schilling, 2021; Van Alstyne et al., 2016; Zhu & Furr, 2016). However, recent decades have witnessed a huge transformation, with the rise of ICTs reducing the need for physical infrastructure and assets (Van Alstyne et al., 2016; Vaska et al., 2021). These technologies make it easier and more cost-effective to build and expand platforms, enhance network effects through simplified participation, and enable the capture, analysis, and evaluation of vast amounts of data, increasing the platform’s value for all participants (Van Alstyne et al., 2016). Unlike traditional businesses that create content, DPs provide an infrastructure for market participants, facilitating the exchange of products or data-driven services between these participants (Gawer, 2021; Van Alstyne et al., 2016; Liu et al., 2021; Zhu & Furr, 2016). The central role of these DPs is to enable and mediate interactions between market participants, creating value for all involved parties (Rochet & Tirole, 2006; Parker et al., 2016; Liu et al., 2021; Goertler et al., 2023). In this regard, a platform business can be defined as a business that facilitates value-creating interactions between external producers and consumers through the provision of an open and participatory infrastructure and governance conditions (Parker et al., 2016). The overarching goal of such a DP is to match users and facilitate the exchange of goods, services, or social currency, thereby enabling value creation for all participants (Parker et al., 2016).

The contemporary marketplace is being shaped by the proliferation of DPs and the corresponding ecosystem. Recent years have witnessed a trend toward the increasing prevalence of DP markets as venues for economic activity, as evidenced by a growing body of literature (Liu et al., 2021; Rietveld & Schilling, 2021; Kretschmer et al., 2022). Competition in this new arena is no longer solely about mastering the value chain: it is about attracting generative activities related to a DP (De Reuver et al., 2018) and fostering interaction between disparate participants within the BE (Van Alstyne et al., 2016). Given the importance of DPs and BEs in shaping the business environment and value creation (Alexander et al., 2022; Anderson et al., 2022; Frederico et al., 2019), it is imperative that a thorough examination of their evolution be undertaken. As the field continues to evolve at a rapid pace, the study of BEs has become a critical area of inquiry (Fink et al., 2022; Wagner, 2021).

3. Research design and methodology

To support our research focus, we performed a systematic literature review in line with Cooper (2017) to identify relevant literature from the scientific community. Cooper’s (2017) framework provides a comprehensive approach to research synthesis that extends beyond the reporting process to focus on the systematic integration and conceptual aggregation of findings. This approach is particularly suitable for our study because our review aims to synthesize qualitative, theoretical, and conceptual insights across a diverse body of literature on DP ecosystem design. It also offers a clear structure for synthesizing design themes, identifying recurring patterns, and deriving recommendations. The methodical steps are illustrated in Fig. 1 and outlined as follows.

3.1. Problem formulation

In line with Cooper’s (2017) suggestion, we began our literature review by formulating a review question: *What topics should be considered when designing the BE of a DP?*

3.2. Locating publications

In accordance with Cooper (2017), we defined four academic databases for our literature search: EBSCO host, Web of Science, ScienceDirect, and AISeL. These databases are widely used for literature reviews (Cooper, 2017; Fan & Stevenson, 2018) and were selected to uncover DP design-related publications from both business and information systems domains. To focus on design topics for DPs, we used a search string combining three keyword clusters and applying the Boolean operators AND and OR, along with truncations (Cooper, 2017): *(smart* OR digital* OR iot* OR *sided* OR cloud*) AND (platform* OR market*) AND (taxonom* OR typolog* OR classif*)*.

The search string reflects commonly used DP synonyms, such as multi-sided or two-sided markets (Asadullah et al., 2018). As our focus lies on the identification of design topics for platform BEs, we tried to capture relevant design topics through a focused search with a specific search string. This means we did not focus on a general search for platform BEs (general research level), as the literature already provides a huge amount of publications on this topic. Instead, we tried to focus our search on the identification of specific design topics from the beginning of our study. In other words, the level of analysis was below

Problem Formulation					
RQ: What topics should be considered when designing the BE of a DP?					
Locating Publications					
Search string	(smart* OR digital* OR iot* OR *sided* OR cloud*) AND (platform* OR market*) AND (taxonom* OR typolog* OR classif*)				
Academic databases		Ebsco	AISeL	Web of Science	Science Direct
	Title	18	5	373	661
	Keywords	15	9		
	Abstract	1,789	235		
	Σ Database	1,822	249	373	661
Σ Total	3,105				
Screening of Search Results and Article Selection					
Exclusion criteria	Duplicate removal	2,660			
	Limitation to English language	2,532			
	Journal ranking (ranked in VHB or ABS)	968			
Inclusion criteria	DP BE design relevance in title, abstract, full text, as well as sufficient research method	31			
Sample after forward and backward search		13			
Final sample		44			

Fig. 1. Systematic literature review following Cooper (2017).

the generic level of a platform BE. In conclusion, the search string was designed to facilitate a comprehensive and generic search to capture a diverse range of literature related to platforms, taxonomies, typologies, or classifications. The search string allows for a comprehensive coverage of studies related to DPs, without predefining or limiting the scope to specific domains, industries, or contexts. Furthermore, it enables the identification of unlabeled or emergent themes during the analysis phase, particularly with regard to ecosystem-related aspects. Additionally, it facilitates the focus on the structural and conceptual categorization of platforms through terms like “taxonomy”, “typology”, and “classification”, which align with the objectives of synthesizing design themes. Our search using the string in the title, abstract, and keywords of the four databases produced 3105 hits.

3.3. Screening of results and article selection

We took three steps to filter the initial list of studies to find those that provide valuable information for solving the problem (Cooper, 2017). First, duplicates were eliminated, reducing the initial list to 2660 unique hits. Next, a multi-stage filtering process was applied to ensure the quality and relevance of the selected studies. To assess academic quality, papers not written in English were excluded, and non-academic sources such as non-scientific conference papers, industry reports, and opinion articles were removed. Additionally, studies published in journals not indexed in the ABS or JOURQUAL rankings were systematically filtered out, as these provide established benchmarks for academic quality. This step resulted in a refined list of 968 publications. Following this quality assessment, a content-based screening process was conducted. Titles, abstracts, and full texts were examined to determine whether a study aligned with the research objective. Specifically, we included only studies that addressed the design or structuring options of ecosystems in the context of digital platforms. This ensured that all selected publications provided conceptual or empirical insights into the design of digital platform ecosystems. Finally, we applied forward and backward citation searches, as suggested by Webster and Watson (2002), to identify additional relevant studies. This resulted in a final sample of 44 rigorously selected and high-quality publications.

3.4. Analysis and synthesis of publications

We analyzed the selected publications for relevant design aspects and used the BE framework according to Adner (2017) to structure our synthesis of the findings. By conducting a qualitative content analysis, following Mayring (2021), we identified design recommendations and related topics from the publications. The authors synthesized these topics with reference to the key elements of ecosystem structure (*activities, actors, positions, links*), and we collaborated to ensure the reliability and validity of the synthesis. In the following sections we present the results of our descriptive and content-related analysis.

4. Results

4.1. Descriptive analysis

The identified final sample consists of eleven conference papers, 30 journal publications, two reports, and one book chapter. Conferences considered include the European Conference on Information Systems, the International Conference on Advanced Information Systems Engineering, the Hawaii International Conference on System Sciences, the International Conference on Engineering, Technology and Innovation, and Wirtschaftsinformatik.

The *Journal of Marketing*, the *Strategic Management Journal*, the *Journal of Manufacturing Technology Management*, the *Journal of International Management*, the *Journal of Theoretical and Applied Electronic Commerce Research*, the *European Journal of Innovation Management*, the *Asian Journal of Technology Innovation*, the *European Journal of*

Marketing, the *Industrial Marketing Management*, the *Journal of Business Ethics*, the *Vietnam Journal of Computer Science*, the *European Management Journal*, the *Journal of Management Information Systems*, the *International Journal of Conceptual Modeling*, *Research Policy*, *Technovation*, *Electronic Markets*, *Computers & Industrial Engineering*, *Electronic Commerce Research*, *Information Systems and e-Business Management*, *Enterprise Information Systems*, and *Sinergie Italian Management Journal* constitute the source for the 30 journal papers.

Examination of the publication frequency over the course of several years has led to the conclusion that, with the exception of two papers, all publications concerning DP BE configuration options were disseminated between 2018 and 2024. This finding indicates a modest but discernible escalation of scholarly interest in the aforementioned subject matter within the past seven years, as illustrated by appendix 2.

4.2. Content-related analysis

Table 1 synthesizes our results and offers a comprehensive overview of the design topics identified for each key element. The subsequent section delineates these findings in detail.

4.2.1. Activities

According to Adner (2017), the initial key element of structure is referred to as *activities*. Adner (2017) positioned the value proposition as the cornerstone of the ecosystem, establishing it as the proposed value proposition that sets the endogenous boundary for the pertinent ecosystem. In our literature analysis we were able to identify the following topics as activities: integration of complementors (1.1), offer preparation by complementors (1.2), incentives for participation (1.3), establishment of trust (1.4), asset structure and ecosystem design (1.5), governance decisions (1.6), centrality decisions (1.7), data governance and analytics capabilities (1.8), and ecosystem resilience and adaptability (1.9).

The integration of complementors (1.1) describes the extent to which complementors are integrated into the ecosystem and how the access restrictions of the DP are constructed. Complementors can be completely excluded, manually selected, or admitted based on specific access conditions (Abendroth et al., 2021; Bally et al., 2024; Blaschke et al., 2019; Den Hartigh et al., 2023; Doligalski, 2023; Franzò & Urbinati, 2023; Geske et al., 2021; Hodapp et al., 2019; Kazan et al., 2018; Tessmann & Elbert, 2022; Wang et al., 2024; Zutshi & Grilo, 2019). Integrated complementors thus have the opportunity to contribute certain offers to the DP to achieve the common purpose (Geske et al., 2021). Examples of offer preparation by complementors (1.2) include resources, interactions, technologies, services, and combinations thereof (Geske et al., 2021; Iasevoli et al., 2018; Kazan et al., 2018; Perscheid et al., 2020; Rix et al., 2020). Other design topics for the key element *activities* are incentives for participation (1.3) and the establishment of trust (1.4). The incentives created by the DP are intended to motivate actors to participate in platform activities and – according to the literature – can be monetary or non-monetary in nature (Abendroth et al., 2021; Li et al., 2024; Motamedimoghadam et al., 2024; Rix et al., 2020; Wang et al., 2024; Wichmann et al., 2022). However, a certain foundation of trust is necessary to achieve stakeholder participation, and this trust needs to be established for the technologies used, for the DP itself, as well as for the encompassing community (Zutshi & Grilo, 2019; Perscheid et al., 2020; Lage et al. (2022); Šilenskytė et al. (2024)). Asset structure and ecosystem design (1.5) describes the general structure of the DP and, according to the literature, is based on two different aspects. Thus, the platform is composed of its own asset structure and the ecosystem surrounding the DP (Abed Alghani et al., 2024; Evans & Gawer, 2016). In terms of asset structure, it shows how much access a company has to the necessary resources to create the value proposition and, in contrast, how much dependence it has on other companies that can provide access to the necessary resources. Gawer (2014) also addressed governance decisions (1.6). In today’s business environment, which is characterized by

Table 1
Overview of design topics identified for each key element of structure.

Key element of structure	Design topic	Description
(1) Activities	(1.1) integration of complementors	This aspect examines the degree to which complementors are integrated into the ecosystem and how access restrictions to the DP are defined.
	(1.2) offer preparation by complementors	Refers to how complementors prepare offers, including resources, interactions, technologies, services, or combinations thereof.
	(1.3) incentives for participation	Describes the mechanisms through which the DP motivates actors to engage in platform activities.
	(1.4) establishment of trust	Emphasizes the need to establish trust in the DP's technologies, the platform itself, and the broader community to ensure stakeholder participation.
	(1.5) asset structure and ecosystem design	Defines the general structural setup of the digital platform and its surrounding ecosystem.
	(1.6) governance decisions	Highlights the legal and operational frameworks necessary to manage and monitor the platform effectively.
	(1.7) centrality decisions	Focuses on strategic decisions regarding platform organization, whether centralized and hierarchical or decentralized and market-driven.
	(1.8) data governance and analytics capabilities	Examines how data is collected, analyzed, and utilized for value creation in platforms.
	(1.9) ecosystem resilience and adaptability	Examines how platforms adapt to market changes and disruptions to ensure long-term success.
(2) Actors	(2.1) platform participants	Identifies the primary business relationships and potential participant base within the platform ecosystem.
	(2.2) platform operator	Refers to the entity responsible for managing and operating the platform.
	(2.3) key partners	Highlights the most essential partnerships that support the platform operator.
	(2.4) resource owner	Describes the ownership and control over the content or assets available on the platform.
	(2.5) complementors	Focuses on the capabilities and resources complementors need to succeed in the ecosystem.
(3) Positions	(3.1) access to resources	Examines the platform's ability to provide access to business-relevant resources.
	(3.2) strategic positioning	Focuses on the DP's intended initial purpose and strategic orientation.
	(3.3) geographical coverage	Addresses the platform's geographical scope and area of application.
(4) Links	(4.1) relationship among platform participants	Considers the relationships between producers and consumers for value creation and exchange within the platform's marketplace.
	(4.2) interaction behavior of platform participants	Highlights how participants interact within the platform ecosystem.
	(4.3) marketplace	Examines whether the DP offers a marketplace or enables the use of external application sales channels.
	(4.4) digital infrastructure interconnectivity	Examines how platforms utilize and integrate digital infrastructure for collaboration and interaction.

growing uncertainty, increased complexity, and high dynamics, it is even more important for companies to achieve efficient regulation and flexible governance (Bally et al., 2024; Caiazza et al., 2023). Governance provides the legal and factual framework for DPs to manage and monitor

an organization. This is followed by decisions relating to centrality (1.7). This deals, for example, with decisions regarding platform strategies, which can be either centralized or hierarchical, or decentralized or market-driven (Derave et al., 2020; Derave et al., 2021; Perscheid et al., 2020; Tessmann & Elbert, 2022). Numerous intermediate forms also exist in this context, with parts of the DP organized along centralized lines (Derave et al., 2020; Derave et al., 2021; Tessmann & Elbert, 2022) and others decentralized (Lage et al., 2022; Perscheid et al., 2020), with a focus on coordination (Staub et al., 2021). Other design topics of activities include data management and analysis capabilities (1.8) and resilience and adaptability of the ecosystem (1.9). In the context of data management and analytics capabilities (1.8), aspects such as efficient use of resources (Heinbach et al., 2022), data-driven business models (Endres et al., 2024), and analytics and data governance for the IIoT (Arnold et al., 2022; Endres et al., 2024) play a crucial role in DP ecosystems. Furthermore, structural dynamics (Abed Alghani et al., 2025), continuous adaptation of strategies (Ventura & Silva e Meirelles, 2025), and the transition from proprietary platforms to resilient and adaptable ecosystems (Nerbel & Kreutzer, 2023) represent important aspects that can ensure ecosystem resilience and adaptability (1.9) within DP ecosystems.

4.2.2. Actors

As posited by Adner (2017), *actors* are the entities that carry out the activities. Given that diverse actors may hold distinct viewpoints and intentions regarding the composition of the set of partners, a collaborative value-creation endeavor serves as a common objective for all actors involved in the ecosystem (Adner, 2017). By means of our review, the following topics could be identified for actors: platform participants (2.1), platform operator (2.2), key partners (2.3), resource owner (2.4), and complementors (2.5).

Platform participants (2.1) basically comprise producers and consumers (Iansiti & Levien, 2004; Van Alstyne et al., 2016). In this context, platform participants refer, on the one hand, to basic types of business relationship between actors – B2B, B2C, C2C, P2P – or other participants (Derave, 2019; Derave et al., 2020; Derave et al., 2021; Hodapp et al., 2019; Perscheid et al., 2020; Rix et al., 2020; Täuscher & Laudien, 2017, 2018). On the other hand, market participants (Fruhworth et al., 2020), platform participants (Staub et al., 2021; Täuscher & Laudien, 2018), customer types (Hodapp et al., 2019; Rix et al., 2020), or user segments (Täuscher, 2016) describe the potential participant base of a platform ecosystem. In addition to the platform participants (2.1), the forms of expression of the design topic of the platform operator (2.2) are also determined for the key element *actors*. In this respect, the literature distinguishes between small and mid-sized, large enterprises, joint ventures, open-source operators, or mixed forms regarding the platform operator, and their background can be in different industries (Abendroth et al., 2021).

In the design topic key partners (2.3), the most elementary partners of the platform operator are presented. In this context, a differentiation is made between competitors and non-competitors, the method of piggybacking (Osterwalder & Pigneur, 2010; Rix et al., 2020), and significant customers (Rix et al., 2020). Following Rix et al. (2020), partnerships have the potential to confer benefits and enhance the appeal of a DP, but they can also result in dependencies that curtail flexibility. Collaborating with competitors may aid in expediting the attainment of critical mass for existing offerings (Rix et al., 2020), while forging strategic partnerships with non-competitors can facilitate the outsourcing of non-core activities (Rix et al., 2020). Furthermore, smaller firms can leverage piggybacking, namely, partnering with larger companies to leverage their experience or network (Parker & Van Alstyne, 2014). Another potential avenue for advantageous partnerships is with major customers, wherein a firm can secure enduring relationships, improve customer consultation and efficient fulfillment of requests, generate predictable sales, and tailor the DP's offerings to specific requirements (Rix et al., 2020). The resource owner (2.4) takes

into consideration ownership of the platform content, where ownership can be held by a private individual, on the one hand, or by a company, on the other (Chasin et al., 2018). Complementors (2.5) also represent a key partner in the digital platform (DP) ecosystem due to their specific capabilities (Doligalski, 2023; Li et al., 2024; Motamedimoghdam et al., 2024; Shim, 2024; Tian et al., 2022; Wichmann et al., 2022) and/or their distinct types (Abendroth et al., 2021), enhancing the value of a DP by providing complementary products or services (Doligalski, 2023; Shim, 2024). This, in turn, fosters network effects and contributes to the innovation potential and scalability of the DP ecosystem.

4.2.3. Positions

Positions pertain to the arrangement of system actors within the flow of activities, serving to determine the transfer of accountability from one actor to another (Adner, 2017). Following Adner (2017), it is critical for a company, operating within the ambit of its ecosystem strategy, to ensure that its partners occupy the designated positions and fulfill the assigned roles envisioned in the ecosystem strategy. Based on the review, a number of topics could be identified for this key element: access to resources (3.1), strategic positioning (3.2), and geographical coverage (3.3).

The first design topic, access to resources (3.1), can differ at the ecosystem level; in other words, access can, for example, only be granted internally within the company, within the supply chain, or within the entire ecosystem (Gawer, 2014). If companies do not have access to relevant resources because they are otherwise only accessible internally, these companies are increasingly dependent on strategic partnerships and thus also on other actors. Resources are accessible to the supply chain if a company has decided to open up its DP and integrate other actors in the ecosystem. The strategic positioning (3.2) of the DP refers to the initial intended use of the DP. Some DPs have been developed for internal purposes, for example, and are used exclusively for this purpose. Others were originally developed for internal use but are currently also accessible to external participants. In contrast, some DPs have been designed for external use from the beginning (Abendroth et al., 2021). In addition, the strategic positioning of the platform operator (Den Hartigh et al., 2023) is essential to enhance value creation. The design topic of geographical coverage (3.3) provides information about the application and scope of the platform. In this context, the literature distinguishes between regional, national, and international (Abendroth et al., 2021; Chasin et al., 2018; Evans & Gawer, 2016; Rix et al., 2020; Täuscher, 2016). This is particularly relevant with regard to individual market needs or the location of the headquarters of globally operating companies (Evans & Gawer, 2016).

4.2.4. Links

Links refer to the transfers of various elements, such as material, information, influence, and funds, across actors in the ecosystem, without necessarily having any direct connection to the focal actor (Adner, 2017). Within the ecosystem-as-structure approach, links are established based on the alignment requirements that generate positions in the overarching value blueprint (Adner, 2017). From our review, three topics were identified as links: the relationship among platform participants (4.1), the interaction behavior of platform participants (4.2), the marketplace (4.3), and the digital infrastructure interconnectivity (4.4).

The number of participating users within the types mentioned above in 4.1.2 (B2B, B2C, C2C, P2P) is examined in more detail in the relationship among platform participants (4.1), as the ecosystem design must consider the relationship between producers and consumers for value creation and exchange in specific marketplaces (B2B, B2C, C2C, P2P). Thus, for example, in a one-to-one or one-sided relationship, only one participant per side can be facing the other (Wang & Archer, 2007). In a many-to-many or multi-sided relationship, on the other hand, a large number of participants sit opposite one another on both sides, with intermediate levels of the two characteristics being, for example, one-to-

few, one-to-many, or few-to-few relationships (Derave et al., 2020; Derave et al., 2021; Perscheid et al., 2020; Wang & Archer, 2007). Furthermore, the interaction behavior of the participants also differs, which is described by design topic 4.2. The literature refers to the two possible forms of expression as either collaborative (Rix et al., 2020) or competitive (Staub et al., 2021). The last design topic of the key element, *links*, is the marketplace (4.3), which describes whether a marketplace is offered in connection with the DP (Arnold et al., 2021; Arnold et al., 2022; Gleim et al., 2023) or whether the option to application sales channels exists (Hodapp et al., 2019). If this is offered, the forms of the design topic differ between an internal – platform-owned – marketplace and an external – non-platform or outsourced – marketplace (Arnold et al., 2021; Hodapp et al., 2019). For example, firms in a B2B context, such as an automotive OEM, try to establish a platform-owned and company-restricted marketplace to manage global inbound logistics in their ecosystem. Meanwhile, firms that operate at the intersection of B2B and B2C, for example, a technology retailer who also sells related product insurance, follows a non-platform or outsourced marketplace design. The examination of digital infrastructure interconnectivity (4.4) involves the analysis of how platforms utilize and establish connections with digital infrastructure to enable interactions and collaborative efforts among participants. In this context, blockchain technology (Lage et al., 2022; Šilenskýtė et al., 2024) and a cloud-based infrastructure (Caiazza et al., 2023) are recognized as significant mechanisms for establishing digital connectivity.

5. Discussion and conclusions

The purpose of this study was to contribute to and advance existing research on designing DP-ecosystems in a SCM context by adopting Adner's (2017) ecosystem-as-structure conceptualization. Based on a literature review (Cooper, 2017; Webster & Watson, 2002), the authors synthesized previous work regarding ecosystems and provided further insights into their design. In other words, the literature review revealed design issues that the authors assigned to the ecosystem-as-structure conceptualization of an ecosystem (see Table 1). A content analysis (Mayring, 2021) supported this assignment. Scholars and practitioners can find behind the structural elements *activities*, *actors*, *positions*, and *links* design options resulting from the scientific literature. Further information on this literature can be found in appendix 1.

Regarding Table 1 and our findings, the authors assigned most of the design topics to the structural element *activities* (9 out of 21). This could demonstrate that issues concerning ecosystem activities are frequently addressed by academia. A closer look at the structural element *activities* shows that most activities focus on governing or managing the participation and value co-creation in an ecosystem, such as design topic integration of complementors (1.1), incentives for participation (1.3), establishment of trust (1.4), or governance decisions (1.6). This finding corresponds to other studies, such as Adner and Kapoor (2010), Hannah and Eisenhardt (2018), and Prockl et al. (2022), and should therefore be considered by scholars and practitioners in realizing an ecosystem. In comparison with the structural elements of *activities* and *actors*, the authors identified fewer design topics that could be assigned to the structural elements of *positions* and *links* (see Table 1). With the exception of existing studies on platform leaders (for example, Gawer, 2021; Gawer & Cusumano, 2014), this finding could mean that the structural elements *positions* and *links* are less frequently investigated in detail. From the author's point of view, this finding corresponds to the understanding that ecosystems, especially *positions* and *links*, represent a comprehensive and complex unit of analysis (Adner, 2017; Jacobides et al., 2018) and that detailed design topics and related recommendations depend, for example, on the research perspective (focal actor for ecosystem design), value proposition, and industry context. The findings of our study provide some contributions to academia. By applying the ecosystem-as-structure conceptualization of an ecosystem (Adner, 2017), the presented results and Table 1 attempt to provide interesting

design topics and thus help to devise an ecosystem. The authors believe this study contributes to and advances important research on ecosystems in a SCM context (see, for example, Fink et al., 2022; Felch & Sucky, 2022; Jacobides et al., 2018; Prockl et al., 2017; Wagner, 2021). This study structurally synthesizes existing work relating to the design of an ecosystem and has the potential for both demonstrating gaps and aligning avenues for further research. Moreover, the design issues presented provide insights for ecosystem design in various industries. This study also offers practitioners insights for ecosystem development. Table 1 summarizes specific ecosystem design topics and thus supports development and resource allocation in projects for establishing an ecosystem. In other words, the findings of this study and Table 1 represent a possible design framework for developing an ecosystem.

The findings suggests that detailed design topics and related recommendations for ecosystem design depend on the research perspective, value proposition, and industry context. This implies that there may be a need for more research to explore the various perspectives, value propositions, and industry contexts that can influence ecosystem design. A possible question could be how do different research perspectives, value propositions, and industry contexts impact ecosystem design, and what are the most effective strategies and approaches for designing ecosystems that are tailored to specific contexts and stakeholder needs? In addition, the existing framework used to study ecosystem design can be extended by adding further dimensions. One possibility is to add a temporal dimension to explore how ecosystem design topics change over time in response to market, technological, and social conditions and investigate the effectiveness of different ecosystem designs in different stages of the ecosystem's life cycle. Another option is to add a cross-industry dimension to examine how ecosystem design differs in industries with different market structures, levels of technological innovation, regulatory environments, and cultural contexts. Additionally, future research can explore how ecosystem performance can be measured and optimized, and how different design choices may impact ecosystem outcomes such as innovation, growth, and profitability. Based on the results, we have also formulated the following questions for future research:

1. How do different types of digital platforms influence the design and structure of their associated business ecosystems?
2. What are the key challenges and opportunities in managing business ecosystems for different types of digital platforms?
3. How do platform type variations affect the value co-creation processes among business ecosystem participants?
4. What are the critical success factors for effectively implementing the identified design characteristics in digital platform ecosystems?
5. How can platform operators leverage the identified design characteristics to foster innovation and competitive advantage within their business ecosystems?

Appendix A. Appendix

Appendix 1

Business ecosystem key elements and detailed references.

Business ecosystem key elements and detailed references

1 Activities

- Value Creation Architecture [Kazan et al., 2018]
- Integrated complementor [Geske et al., 2021; Doligalski, 2023; Bally et al., 2024; Den Hartigh et al., 2023; Franzò & Urbinati, 2023; Tessmann & Elbert, 2022]
- Complementor openness [Abendroth et al., 2021]
- Ecosystem Dimension [Blaschke et al., 2019; Abed Alghani et al., 2024]
- Discovery and acquisition of collaborators [Zutshi & Grilo, 2019; Wang et al., 2024]
- Partner system [Hodapp et al., 2019]
- Value creation architecture [Kazan et al., 2018]

1.1 Integration of complementors

1.2 Offer preparation by complementors

6. What are the measurable outcomes of applying different design characteristics in terms of ecosystem performance?

However, this study suffers from some limitations. The literature review conducted depends on the quality and performance of the scientific database used. The authors considered publications with a certain string [(*smart* OR digital* OR iot* OR *sided* OR cloud**) AND (*platform* OR market**) AND (*taxonom* OR typolog* OR classif**)] in the title, keywords, or abstract. Readers should not rule out the possibility that there are publications available that discuss the unit of analysis but which do not contain this string. The authors also believe that more research is required to detail our understanding of the design of an ecosystem in an SCM context. The authors identified a number of design topics in the structural elements of *activities* and *actors*; however, they identified fewer topics in the structural elements of *positions* and *links*. Consequently, avenues for further research might focus especially on these structural elements and point out ecosystem-related design topics. In other words, scholars could examine which roles and positions are suitable for certain companies of a specific industry. Considering the life cycle of an ecosystem, scholars could also investigate how strategic positioning and related links change over time. They could also address the issue of resilience (Wieland & Durach, 2021) and analyze how the links of an ecosystem could be dynamically managed in terms of disruptions. Moreover, researchers could investigate possible interdependencies between the design topics presented. It is important to note that the digital platform industry operates within a multitude of regulatory, economic, and cultural environments across nations. As a result, it is essential to acknowledge that country-specific factors, such as regulatory frameworks and technological infrastructure, may significantly influence the design of platform ecosystems. While the included studies predominantly adopt a global perspective, the proposed framework should be carefully evaluated for contextual applicability, as unique national conditions can shape platform ecosystem design in distinct ways. Finally, the study did not focus on a certain industry. Thus, the presented design topics could be specified to a certain industry, such as chemicals, manufacturing, or healthcare.

CRedit authorship contribution statement

Thomas Goertler: Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Marcel Papert:** Writing – review & editing, Methodology. **Isabel Fischer:** Writing – review & editing, Methodology. **Malou Schmidt:** Writing – review & editing.

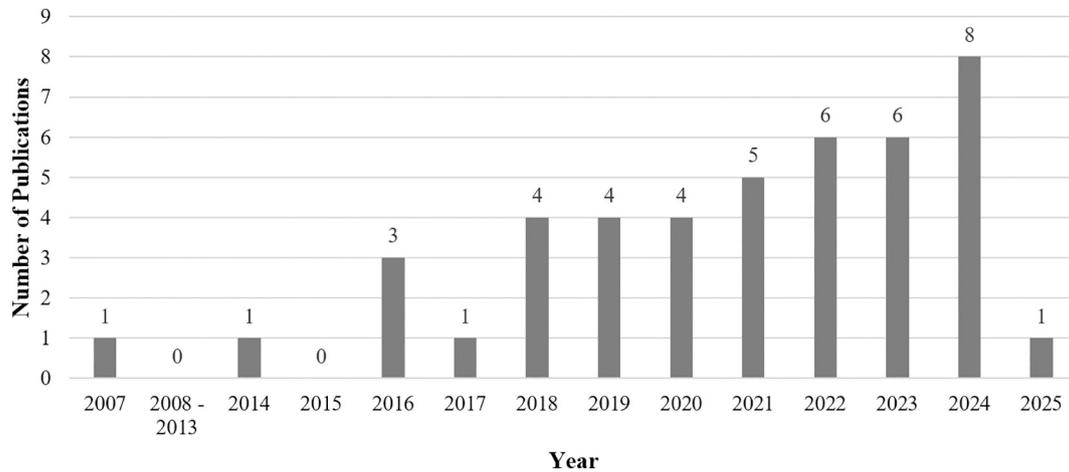
Declaration of competing interest

None.

(continued on next page)

Appendix 1 (continued)

	<ul style="list-style-type: none"> • Integrated complementor offering [Geske et al., 2021] • Value from demand side [Iasevoli et al., 2018] • Key (external) stakeholders [Perscheid et al., 2020] • Support of external value creation [Rix et al., 2020] • Participation incentives [Abendroth et al., 2021; Li et al., 2024; Motamedimoghadam et al., 2024; Wang et al., 2024; Wichmann et al., 2022]
1.3 Incentives for participation	<ul style="list-style-type: none"> • Virality mechanism [Rix et al., 2020]
1.4 Establishment of trust	<ul style="list-style-type: none"> • Building trust [Zutshi & Grilo, 2019] • Role of trust [Perscheid et al., 2020; Lage et al., 2022; Šilenskytė et al., 2024]
1.5 Asset structure and ecosystem design	<ul style="list-style-type: none"> • Structure of assets and design of ecosystem [Evans & Gawer, 2016; Abed Alghani et al., 2024] • Necessity of governance [Gawer, 2014; Bally et al., 2024; Caiazzo et al., 2023] • Evolution of governance decisions [Nerbel & Kreutzer, 2023]
1.6 Governance decisions	<ul style="list-style-type: none"> • Resource usage within circular ecosystems [Franzò & Urbinati, 2023] • Marketplace operations [Gleim et al., 2023] • Facilitating collaboration [Tian et al., 2022] • Decisional openness [Abendroth et al., 2021] • Centralization [Derave et al., 2020; Derave et al., 2021; Tessmann & Elbert, 2022]
1.7 Centrality decisions	<ul style="list-style-type: none"> • Orientation [Stahl et al., 2016] • Relationship dimension [Wang & Archer, 2007] • Coordination [Staub et al., 2021] • Degree of (de)centralization [Perscheid et al., 2020; Lage et al., 2022] • Efficient resource usage [Heinbach et al., 2022]
1.8 Data management and analytics capabilities	<ul style="list-style-type: none"> • Data driven business models [Endres et al., 2024] • Data analytics and governance for IIoT [Endres et al., 2024; Arnold et al., 2022] • Structural dynamics [Abed Alghani et al., 2024]
1.9 Ecosystem resilience and adaptability	<ul style="list-style-type: none"> • Continuous adaptation of strategies [Ventura & Silva e Meirelles, 2025] • Transition from proprietary platforms to resilient and adaptable ecosystems [Nerbel & Kreutzer, 2023]
2 Actors	
	<ul style="list-style-type: none"> • Marketplace participants [Täuscher & Laudien, 2017; Derave, 2019; Fruhwirth et al., 2020] • Platform participants [Täuscher & Laudien, 2018; Perscheid et al., 2020; Staub et al., 2021] • Participation [Derave et al., 2020]
2.1 Platform participants	<ul style="list-style-type: none"> • Customer type [Hodapp et al., 2019] • User segments [Täuscher, 2016] • Participation [Derave et al., 2021] • Customer segments types [Rix et al. (2020)]
2.2 Platform operator	<ul style="list-style-type: none"> • Platform operator [Abendroth et al., 2021; Den Hartigh et al., 2023]
2.3 Key partners	<ul style="list-style-type: none"> • Key partnerships [Rix et al. (2020)]
2.4 Resource owner	<ul style="list-style-type: none"> • Resource ownership [Chasin et al., 2018]
2.5 Complementors	<ul style="list-style-type: none"> • Capabilities [Shim, 2024; Doligalski, 2023; Tian et al., 2022; Li et al., 2024; Motamedimoghadam et al., 2024; Wichmann et al., 2022] • Complementor types [Abendroth et al. (2021)]
3 Positions	
3.1 Access to resources	<ul style="list-style-type: none"> • Resource accessible capabilities [Gawer, 2014]
3.2 Strategic positioning	<ul style="list-style-type: none"> • Origin of platform [Abendroth et al. (2021)] • Platform operator [Den Hartigh et al., 2023] • Geographic distribution [Abendroth et al. (2021)] • Geographic scope [Täuscher, 2016] • Global integration [Chasin et al., 2018]
3.3 Geographical coverage	<ul style="list-style-type: none"> • Headquarter geography [Evans & Gawer, 2016] • Customer segment place [Rix et al. (2020)]
4 Links	
4.1 Relation among platform participants	<ul style="list-style-type: none"> • Market sides [Derave et al., 2020; Derave et al., 2021] • Number of participants [Wang & Archer, 2007] • Platform periphery [Perscheid et al., 2020]
4.2 Interaction behavior of platform participants	<ul style="list-style-type: none"> • Interaction mode [Staub et al., 2021] • Interest interpretation [Rix et al. (2020)]
4.3 Marketplace	<ul style="list-style-type: none"> • Marketplace [Arnold et al., 2021; Arnold et al., 2022; Gleim et al., 2023] • Application sales channels [Hodapp et al. (2019)]
4.4 Digital infrastructure interconnectivity	<ul style="list-style-type: none"> • Blockchain technology for digital connectivity [Šilenskytė et al., 2024; Lage et al., 2022] • Cloud-based infrastructure for digital connectivity [Caiazzo et al., 2023]



Appendix 2. Yearly distribution of publications.

Data availability

No data was used for the research described in the article.

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