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RESEARCH PAPER

Digital platform ecosystems in flux: From proprietary digital platforms to wide-spanning ecosystems

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Abstract
Digital Platform Ecosystems (DPEs) represent a distinct form of interorganizational relationship cultivated on digital infrastructures. Although DPEs are researched extensively among management scholars, shortcomings in formalizing their emergence remain. Particularly re-occurring patterns and temporal dimensions of emergence continue to be relatively unexplored. We review existing literature in an integrative manner and shed light on DPE emergence by deriving a framework comprising four distinct stages. We thereby sharpen the understanding of DPEs and bring convergence to an increasingly fragmented field of research by accounting for industrial innovation management, organizational, market-based, and ecosystem-based views. As a result, we present a classification of DPE emergence stages and related key activities contributing to the progression from a nascent digital platform into a wide-spanning DPE. Finally, we propose multiple avenues for future research.

Keywords Ecosystem · Platform · Emergence · Complementarity

JEL Classification M1

Introduction

Digital Platform Ecosystems (DPEs) build upon a focal digital platform as the locus of control within a technology-based business system (Cusumano & Gawer, 2002; Gawer & Cusumano, 2008) and incorporate complementarities from various actors undertaking discrete actions to contribute to the platforms' value proposition (Adner, 2017; Jacobides et al., 2018; Teece, 2018). Since 2007, when Apple introduced the first iPhone, complemented by its ever-growing App Store, DPEs have become integral parts of modern societies. DPEs not only monetize already existing assets, such as Facebook monetizing the social networks of individuals or LinkedIn monetizing their professional networks, but also aim to create additional value from previously underused consumer assets. DPEs sometimes even alter market compositions as a whole and are expected to play a key role in future digitalization efforts (Cennamo, 2021).

The concepts of digital platforms and their surrounding ecosystems also have become a vibrant research area, ranging from technical designs in the information science literature (Gawer, 2014) to their impact on organizations within the management science literature (Cusumano & Gawer, 2002). While researchers with an ecosystem perspective often present simplified views of platforms (Adner, 2017), studies on platforms are typically more distinct and can be separated into different research streams (Thomas et al., 2014). DPEs as exclusively digital infrastructures draw on previous studies from platform research but incorporate further dynamics. Some of these dynamics have been researched extensively; nevertheless, the overarching picture has not been drawn yet. Significant research gaps persist foremost in explaining the emergence of a nascent digital platform and its progression into a wide-spanning DPE. Guiding review papers emphasize the importance of conducting further studies investigating antecedents and patterns of DPE emergence (de Reuver et al., 2018; Hein et al., 2020; McIntyre & Srinivasan, 2017). Therefore, in this paper, we address the question of how proprietary digital platforms emerge and eventually develop into wide-spanning DPEs?

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Explaining emergence requires a dynamic approach to establish a common language and way of thinking. Van de Ven and Poole (1995) emphasize process theory to conceptualize how activities and events affect phenomena causing constructs to emerge, evolve, or terminate over time (Cloutier & Langley, 2020; Langley, 1999). Like technology-based organizations (Kazanjian, 1988), DPEs undergo stages of creation, growth, persistence, and decline (McIntyre & Srinivasan, 2017; van de Ven & Poole, 1995). As these stages may vary in time and space, largely depending on complexity, size, or reach of the respective DPE, a mechanistic process approach would fall short of considering relevant implications. Thus, by following the notion of van de Ven and Poole (2005), we derive a process narrative and embed DPEs in an emergent flux. Within this flux, we take snapshots of reoccurring patterns that we identify as distinct stages of emergence (Cloutier & Langley, 2020; Tsoukas, 2017).

DPEs' technological infrastructure enables platform-based business models to quickly scale transactions between numerous groups of users that interact on the platform. Hein et al. (2020) distinguish between platforms owned by a peer-to-peer community, a consortium, or a single owner. When platforms are opened for the integration of third-party complementarities, their overall value may increase even further. This may lead to the emergence of a surrounding ecosystem of complementors around the focal digital platform. Numerous firms, such as Facebook and Uber, have proven that the capability to successfully orchestrate an ecosystem around their proprietary digital platforms significantly increases their market capitalization (Hänninen & Smedlund, 2021). These platforms, which are among the most commercially successful, follow the single-ownership archetype. Thus, in this article, we focus on the emergence of DPEs in single ownership. We thereby contribute not only to the scholarly discourse but also provide guidance to managers seeking to create digital platforms and orchestrate ecosystems.

In this article, we elaborate on different research streams, each contributing to our understanding of DPEs. By conducting an integrative review and theorizing, we further present how DPEs emerge. We outline that a DPE may undergo a maximum of four distinct stages during emergence and highlight that the focal platform firm must successfully execute certain key activities in each stage to let the DPE advance into subsequent stages. Emergence is concluded by the orchestration of a DPE incorporating multiple complementarities.[1] In the following, we present our research methodology and elaborate on present research perspectives from different domains, each contributing central aspects shaping our understanding of DPEs. We then introduce our DPE emergence framework and explain all stages in greater detail. In the concluding section, we establish a problematizing standpoint to the current state of DPE research and outline avenues for future research.

Methodology

We chose an integrative review approach (Elsbach & van Knippenberg, 2020) based on our aims to synthesize existing research on DPE emergence and to derive a framework of DPE emergence as a theoretical contribution to the literature (Snyder, 2019). We thereby provide a broad review of an emerging topic in need of initial synthesis and follow the methodological recommendations for the management field in general (Tranfield et al., 2003) and the information systems literature in particular (Webster & Watson, 2002). Since the terms "platform" and "ecosystem" are widely used within various academic disciplines, we limit the investigated journals to leading outlets in the management science, information science, and economics literature. Specifically, we included all management science, information science, and economics journals that are ranked as 4 or 4* (the highest ranks) in the 2021 Academic Journal Guide (AJG) of the Chartered Association of Business Schools.[2] Mid of July 2022, we used the Web of Science database to conduct a full-text search without historical time constraints for articles within these journals using the terms "platform" or "ecosystem" (being mentioned in the title, abstract, keywords, or article). This search yielded 1,303 articles published until mid of July 2022.

We then screened these 1,303 articles in a two-step process. We started by reading the titles, keywords, and abstracts to identify the articles that cover the emergence, change, or transition of platforms or ecosystems, either already being digital or progressing from non-digital to digital. Whenever it was not explicit, based on the title, keywords, or abstract, whether the article covered these tenets, we opted for retaining it in our sample to avoid losing insights. We thereby reduced the number of articles to 168 articles. We then carefully read all these 168 articles and further reduced the sample by 26 articles that were not sufficiently focusing on our topic. Among others, exclusion criteria were notions of shared platforms instead of proprietary platforms or other types of ecosystems not comprising platforms. This yielded a sample of 142 articles that describe the emergence, change, or transition within platforms or ecosystems.

[1] We acknowledge that certain platform business models may hinder the DPE to reach the final orchestration stage (Boudreau, 2012). In addition, ultimately, the DPE may enter a stage of strategic or technological renewal or even end in decline or obsolescence (Ozalp et al., 2018). These stages are, however, beyond the scope of this article.

[2] https://charteredabs.org/academic-journal-guide-2021

Table 1 Research perspectives on digital platform and ecosystem emergence

Research perspective	Conceptual	Empirical	Pivotal aspects
Industrial innovation management	9 articles (6.1%)	10 articles (6.8%)	Platform architecture, generativity
Organizational	8 articles (5.4%)	14 articles (9.4%)	Capabilities, governance
Market-based	40 articles (27.0%)	21 articles (14.2%)	Competition, value-creation
Ecosystem	10 articles (6.8%)	36 articles (24.3%)	Competition, governance, generativity, value-creation

Table 2 Notions of DPE emergence in the literature

Study	Digital platform formation	Boundary resource creation	Complementor integration	Ecosystem orchestration
Moore, 1993	Birth	Birth	Expansion	Leadership
Tan et al., 2015	Nascent stage, formative stage	Formative stage	Formative stage	Mature stage
Svahn et al., 2017	Digital platform formation	Boundary resource creation	Complementor integration	-
Sandberg et al., 2020	Modular architecture and device digitization (Master)	Base service digitization and integration (Avant)	Decoupling service and content (AIP)	Toward a platform ecosystem (800xA)
Khanagha et al., 2022	Platform initiation and momentum building	Platform scaling (standardization and co-development)	Platform scaling (relinquishing exclusivity)	Platform scaling (signaling distinctiveness and competitiveness
Stonig et al., 2022	Establishing an integrative platform	Gradually opening the platform	Preparing for non-generic complementarities	Realizing non-generic complementarities in the ecosystem

We acknowledge that Moore (1993) also mentions a self-renewal stage. Since we limit our framework to DPE emergence, decline or self-renewal is beyond the scope of this article

To identify further articles that foster fruitful discussions specifically in the domain of DPE emergence, we cross-checked the reference lists of our sample in a second iteration and identified six promising articles published in the two journals *Communications of the ACM* and *Electronic Markets*. Adding these six articles, we concluded with a final sample of 148 articles. We then coded and sorted these 148 articles into four research streams adapted from previous research in this area (Thomas et al., 2014). These four streams consist of an industrial innovation management, organizational, market-based, and ecosystem perspective. When reading the articles, we also identified re-occurring aspects mentioned in each stream. This was an iterative process in which the author team discussed the key re-occurring aspects and agreed on the best consolidated terms (i.e., aggregating rivalry and competition into one), in the end six pivotal aspects. In Table 1, we provide an overview of the relative distribution of the 148 articles across the four research perspectives, classify the articles as conceptual versus empirical, and highlight the pivotal aspects, which are integral to our subsequently derived DPE emergence framework. We provide detailed overviews of all journals and articles in our sample in the appendix.

In Section 3, we present the four research perspectives and the six pivotal aspects we identified in more depth and integrate these in preparation for our DPE emergence framework. In Section 4, we then build on these pivotal aspects to derive the DPE emergence framework in rich detail. Particularly, we draw upon six empirical in-depth case studies from our final sample that cover a longitudinal perspective on DPE emergence, outlined in Table 2.

Research perspectives shaping our understanding of digital platform ecosystems

Insights from platform technologies, owners, markets, users, and complementors shape our understanding of DPEs and how they interact with each other. Depending on the research area, the perceptions of digital platforms and their surrounding ecosystems vary significantly. Drawing upon previous groundwork presented by Thomas et al. (2014), research perspectives span from an industrial innovation management perspective over an organizational and a market-based perspective to an ecosystem perspective. While certain perspectives, such as the industrial innovation management perspective that includes research from non-digital hardware product platforms and software (Gawer, 2014; Jiao et al., 2007), address both non-digital platforms and

digital platforms in parallel, platforms within the ecosystem stream are mainly digital (Tiwana, 2014). We subsequently pivot the literature and integrate the central aspects related to each research stream, which feed into our framework of DPE emergence.

Research perspectives

Platforms differ between product or non-digital platforms and digital platforms (Gawer, 2014). From an industrial innovation management perspective, a platform is a stable core with a variable incremental periphery (Baldwin & Woodard, 2009; Ghazawneh & Henfridsson, 2013; Tilson et al., 2010; Tiwana et al., 2010). The stable core is usually developed and governed by a single actor, while the variable periphery offers space for modularization and diversified development with several other actors (Baldwin & Clark, 2000; Henderson & Clark, 1990).

According to the organizational perspective, a platform gives organizational order and guidance while storing core competencies and capabilities (Thomas et al., 2014). Schilke et al. (2018) present a comprehensive overview of dynamic capabilities, without a direct link to the context of platforms. The missing linkages and cross-references have also been pointed out by Thomas et al. (2014), who define organizational platforms as a collection of capabilities and resources that enables a firm to respond flexibly to market changes. This aims to maintain a firms' competitive advantage in shifting market environments by treating the platform as a container to generate, combine, re-orientate, and deploy resources and capabilities.

The market-based perspective makes use of theoretical studies from Rochet and Tirole (2002), analyzing competition in the payment card industry. When a platform brings together several user groups, matchmaking takes place and network effects emerge. The underlying concept assumes that the platforms' usefulness and, therefore, value is increased when the user base grows (Katz & Shapiro, 1985; Shapiro & Varian, 1998). Network effects can be either direct or indirect. Network effects are direct, if the platforms' value depends on the number of users in the same user group. In case of indirect network effects, the platforms' value depends, however, on the number of users in a different user group (Clements & Ohashi, 2005; Katz & Shapiro, 1985; Ohashi, 2003).

Within the management science, Moore (1993) initially establishes the ecosystem perspective by drawing upon ecosystems as a biological analogy for describing changing competitive environments. Based on this study several research streams evolved, describing different types of ecosystems. Teece (2007) defines business ecosystems as a community of organizations, institutions, and individuals that impact the enterprise and the enterprises' customers and suppliers. Adner (2006) focuses on innovation ecosystems in which enterprises channel their individual offerings into a coherent, customer-facing solution by making collaborative arrangements. A more recent study again brings convergence by defining an ecosystem as *"a set of actors with varying degrees of multilateral, nongeneric complementarities that are not fully hierarchically controlled"* (Jacobides et al., 2018, p. 2264).

Pivotal aspects and perspective integration

We now elaborate on the six pivotal aspects and integrate them across the four research perspectives.

Platform architecture

General or non-digital platforms often emerge as product families following the notion of internal or supply-chain platforms (Cusumano, 2010; Gawer, 2014; Gawer & Cusumano, 2014). The research on internal platforms anchors within the areas of innovation and product development. Hereby, the creation of product families results in variants addressing different segments within a market (Jiao et al., 2007). Within the machine tool industry, manufacturers often establish internal platforms such that different tools build on platform components, i.e., universal accumulators. Supply-chain platforms expand this view on multiple actors along the supply chain, which is common in the automotive industry. In this context, one supplier often delivers components, for example, engines, to several brands within an industrial conglomerate. There is, however, empirical evidence that internal or supply-chain platforms digitize and eventually become DPEs (Sandberg et al., 2020; Stonig et al., 2022).

Capabilities

Helfat and Raubitschek (2018) bridge the organizational with the ecosystem perspective and identify relevant capabilities for DPEs in general. Capabilities represent a firms' capacity to execute activities in a reliable or at least a minimally satisfactory manner. Within firms, capabilities develop over time through processes, such as learning and acquisitions (Helfat & Martin, 2015). Innovation capabilities reside on both the individual and the organizational level. In ecosystems capabilities do not necessarily reside solely within one organization, but within many ecosystem actors enforcing each other. Many organizations have implemented standardized new product development processes to bundle innovation capabilities, which could ultimately foster the creation of entire DPEs. In these processes firms gather experts from different domains, consider network effects and differentiate between components developed within the firm and acquired through

complementors. As an example, an insurer may seek to develop a health insurance product giving customers preferred access to a network of doctors complemented by telemedical services. While the insurer focuses on the insurance product, the additional services may be brought in by complementors. Furthermore, scanning and sensing capabilities enhance a firms' awareness of new technologies and market opportunities, resulting in either entirely new product contexts or the transformation of existing business areas. Integrative capabilities can typically be found within firms being affiliated with complex supply chains. Hereby, many actors have to be integrated into various processes to create value. Similar situations can be found within DPEs. In a DPE context, many complementors must be integrated into the ecosystem and controlled, depending on the governance decisions of the focal platform. DPEs represent a particular challenge due to the presence of network effects and network externalities. Decisions affecting one side of the platform subsequently impact all other sides of the platform as well (Helfat & Raubitschek, 2018).

Competition

In platform markets competition is present on both a platform- and an ecosystem-level (Cennamo, 2021; Hänninen & Smedlund, 2021). On platform-level different digital platforms may compete for market share. On ecosystem-level there may be competition between complementors in the same ecosystem, between the focal platform firm and its complementors, and between DPEs. On platform-level platform firms may gain a competitive advantage by means of technological superiority, market reach, or pricing (Venkatraman & Lee, 2004). An example are ride-hailing platforms with a similar offering. Given a similar technology and market reach, consumers are likely to prefer the platform, which offers the lowest price. Thus, if there is little room for technological differentiation and similar products or services exist, platform firms usually seek to quickly utilize network effects and achieve a high growth. After establishing high market shares platform firms typically seek to reduce internal costs. In consequence, platform markets are prone to winter-take-all outcomes, in which a dominant firm emerges driving competitors out of the business (Katz & Shapiro, 1986). The picture looks different for competition on an ecosystem-level, where the additional value from complementarities may outweigh the technological properties of the focal platform (Hein et al., 2019b). A prominent example is the mobile phone industry, where the once existing dominant market position of Nokia, largely based on its technological superiority, diminished after the release of the Apple iPhone offering an ecosystem of apps around its handheld (Vuori & Huy, 2016). Nowadays, in this industry competition has shifted entirely to an ecosystem-level between Apple and Alphabet Google DPEs. This development also led to a shift in market architectures (Cennamo, 2021), letting these DPEs seize revenues not only within communications, but also within automotive, logistics, or healthcare. Finally, powerful complementors may also seek to challenge the position either of other complementors or even focal platform firms within an ecosystem (Cennamo & Santaló, 2019; Ozalp et al., 2018; Stonig & Müller-Stewens, 2019).

Generativity

Boudreau (2012) touches upon platform architecture and considers a digital platform as an extensible codebase with third-party modules fostering generativity and complementing to the core. Other studies consider digital platforms as providers of an essential function or set of components (Ceccagnoli et al., 2012) to a technological system, serving as a foundation upon which complementary technologies, products, and services can be developed according to the platform architecture (Spagnoletti et al., 2015; Yoo et al., 2012). Digital platforms thereby incorporate modern technologies, such as cloud computing and big data analytics, to create products and services that operate on a variety of devices (Hein et al., 2019a).

Governance

On platforms, social and economic interactions are mediated or governed. In most cases, the platform leader takes the role of governing the platform. However, there are also cases where the platform community defines a set of rules and builds on a consensus for strategic decisions found in many online wikis or knowledge communities. Centralized platforms are prone to monopolization issues for the cost of the platform community and potential new entrants facing high entry barriers. Platforms eliminate bottlenecks for all sides of the market and enhance the overall market efficiency (Hagiu, 2006). In most cases, platforms do not take ownership of the goods themselves (Hagiu & Yoffie, 2009), although there are a few notable exceptions in the commercial carsharing industry where the platform owner also has the ownership of the cars.

DPEs represent a domain of innovation (Ceccagnoli et al., 2012), which is orchestrated based on the platforms' modular architecture (Kapoor, 2018). The governance between the digital platform and its surrounding ecosystem is moderated by boundary resources, such as Application Programming Interfaces (APIs) and Software Development Kits (SDKs), that establish a common toolset and interpretation standard for complementors to build on (Benlian et al., 2015). The platform ecosystem

concept therefore expands the scope from solely examining a digital platforms' micro perspective over means of communication and collaboration to a macro perspective taking incentives, motivators, and controls for generative complementors into account. Similar to digital and non-digital platforms, there are presumably digital and non-digital platform ecosystems. Non-digital platform ecosystems are however deemed to be out of scope, and the focus is thus narrowed down solely to DPEs in the following.

Most studies dealing with the autonomy of complementors within DPEs have focused primarily on the perspective of the platform owner balancing openness and control (Tiwana et al., 2010). To balance openness and control, the platform owner can use the design of boundary resources (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013) or establish governance mechanisms, which include defining decision rights and review processes (Song et al., 2018; Tiwana, 2014). For example, Facebook offers an open authorization (OAuth) identity service for logging into other services. Based on this service, other platforms, such as shopping platforms, can be integrated into either an existing ecosystem or connect two independent ecosystems with each other to form more extensive digital infrastructures. The creation and combination of APIs may therefore create entirely new digital services, products, or even ecosystems (Evans & Basole, 2016).

Value-creation

The platform design is represented by a one-sided, two-sided, or multi-sided platform. On one-sided platforms, which certain scholars, such as Tiwana (2014), do not consider an actual platform, a platform leader offers products or services to just one homogeneous group of users. Based on the concept of two-sided markets, which again makes use of network effects (Eisenmann et al., 2006; Evans, 2003), two-sided platforms create a common basis for two types of user groups that are linked by the platform and obtain value by interaction (Wright, 2004). Take payment cards as an example of a two-sided market: the perceived value of using payment card services is dependent on both sides of the market, i.e., retailers accepting the payment card and consumers using it for purchases in stores (Rochet & Tirole, 2002). These findings have been generalized into the concept of competition in two-sided markets (Evans, 2003; Rochet & Tirole, 2003). The platform acts as an intermediary or facilitator orchestrating transactions between the two groups (Armstrong, 2006; Boudreau & Hagiu, 2009; Eisenmann et al., 2006; Rochet & Tirole, 2006). Multi-sided platforms facilitate transactions of more than two groups of users (Evans, 2003). An example of a multi-sided platform is Facebook, which incorporates various groups of users and has the tendency to become more valuable with an increase of registered users.

Aspect and perspective integration

All four research perspectives contribute pivotal aspects to our understanding of what DPEs are. DPEs consist of a focal digital platform, boundary resources, and third-party complementarities. The digital platform represents a technology-based business system, on which a focal platform actor enforces control via a digital architecture represented by an extensible codebase that can incorporate third-party modules complementing to its core offering (Boudreau, 2012; Tiwana, 2018). The digital platform channels a one-sided, two-sided, or multi-sided market to enable matchmaking based on either direct or indirect network effects (Eisenmann et al., 2006). Here the focal platform actor requires specific capabilities to form and orchestrate the surrounding ecosystem (Helfat & Raubitschek, 2018), enforces governance principles and fosters generativity, allowing the complementors to undertake discrete actions to contribute to the platforms' value proposition (Adner, 2017; Jacobides et al., 2018; Teece, 2018).

Table 1 lists the outcome of our literature review. All research perspectives deliver valuable insights that complement our understanding of DPEs. The industrial innovation management research perspective contains studies dealing with platform technologies and their technical properties. A main avenue is research on modular digital platform architectures that allow contributing parties to develop complements that operate independently from each other while utilizing a common set of resources (Tiwana, 2008). Scholars determine which capabilities are required for platform firms and how firms can react to market changes (Helfat & Raubitschek, 2018). Platform markets are the subject of the market-based perspective, in which researchers determine how network effects can be utilized and how market transactions can be handled more efficiently by introducing digital platforms (McIntyre & Subramaniam, 2009). The horizon broadens when exploring the surrounding ecosystem of a digital platform from the ecosystem perspective. Independent actors deliver complements to extend platform offerings and may enter or exit the ecosystem in given situations (Ozalp et al., 2018).

Digital Platform Ecosystem emergence

In an early contribution Moore (1993) already outlines the transitional nature of ecosystems and elaborates on four ecosystem stages: birth, expansion, leadership, and

self-renewal. In the following decades, empirical studies catching up on these thoughts to investigate the emergence of digital platforms and their surrounding ecosystems remained however scarce. An explanation is that such investigations are closely linked to the focal platform firms' underlying corporate strategy. Disclosing details in this area may lead to competitive disadvantages. However, some notable exceptions exist.

Tan et al. (2015) study IS capabilities at the Alibaba.com DPE and identify three distinct stages, a nascent stage, a formative stage, and a mature stage, each requiring different capabilities and strategies for success. In the nascent stage, Alibaba created a hub and spoke platform between buyers and sellers by developing trust and a unique value proposition relying on strong IS infrastructures and technical skills. The generation of momentum and the realization of a critical user mass enabled the progression into the formative stage, resulting in a networked platform that enables direct transactions between participants. External relationship management capabilities at Alibaba as the focal platform firm realized enhanced interactivity and identity as well as relinquishing control over interactions. In the mature stage, Alibaba formed a symbiotic DPE and established platform leadership by boosting complementors' organizational capabilities as well as introducing clusters of complementors that represent similar offerings.

Svahn et al. (2017) present an in-depth case study conducted at Volvo Cars, analyzing the creation of a new vehicle-centered digital platform. During platform emergence, Volvo Cars as an incumbent automotive original equipment manufacturer (OEM) has been challenged by four competing concerns: existing vs. requisite capabilities, product vs. process innovation, internal vs. external collaboration, and control vs. flexible governance. These competing concerns represent an initial but incomplete overview of relevant antecedents that cover digital platform formation. From reading the article, we interpret that the authors identify multiple emergence stages. In the first stage, Volvo created the technical and organizational prerequisites to build their products and services based on a digital platform. Subsequently, boundary resources were created to enable complementor participation. With boundary resources in place, key complementors were integrated to the platform, forming the surrounding ecosystem.

Sandberg et al. (2020) present a longitudinal case study conducted at ABB. They investigate how digitization affects product platform transition into DPEs. At ABB, waves of digitization impacted their product platforms enabling digital components and functions. For the transition over time the authors identify four distinct stages, Master, Advant, AIP, and 800xA until a DPE had emerged. In the first stage, ABB focused on modularization and adding new functionality to facilitate interactions between the different sides of their platform. In the second stage, ABB focused on creating the technological prerequisites to enable participation of strategic complementors. In the third stage, ABB formed an ecosystem utilizing the previously created APIs to integrate certified complementors. Ultimately, in the fourth stage, ABB opened their platform even further for a variety of complementors.

Khanagha et al. (2022) present an in-depth case of Cisco and its fog computing platform. Prior to creating its own digital platform Cisco was active as a complementor in another dominant DPE and gathered experience for its own platform launch. After Cisco created the fog computing platform it put emphasis on scaling the platform. Scaling was achieved first by focusing on standardization and openness for co-development, later by relinquishing exclusivity and attracting a variety of complementors. Finally, Cisco aimed to signal distinctiveness and competitiveness to further potential complementors. Stonig et al. (2022) describe similar stages of DPE emergence when studying a major supplier of die-casting machines. In contrast to Cisco, however, this firm started from a non-digital product platform gradually turning digital.

In Table 2, we integrate the notions presented in the literature and derive four distinct stages of DPE emergence. These studies indicate the presence of a nascent stage in which a platform actor forms a digital platform. Opening the digital platform to third party complementarities requires the subsequent creation of boundary resources. With the boundary resources in place, the digital platform may expand and integrate complementors that contribute to its offering and form the surrounding ecosystem. Eventually, the platform actor enters a mature stage where it orchestrates a wide-spanning ecosystem of complementors.

Beyond these few longitudinal empirical studies investigating the emergence process, researchers have made a lot of progress in identifying various factors contributing to digital platform growth and progression. In Table 3, we integrate the pivotal aspects from the literature streams presented in Table 1 into these four stages of DPE emergence and derive key activities for the platform actor to focus on in each stage.

Figure 1 illustrates DPE emergence as a flux (Cloutier & Langley, 2020). In the first stage of DPE emergence, the future platform owner locates a business opportunity for a platform-based product or service and forms a digital platform. The firm makes fundamental design (Tiwana et al., 2010) and governance decisions (Wareham et al., 2014). It is also challenged to attract a viable number of users on the respective sides of the platform to overcome the chicken and egg problem (Caillaud & Jullien, 2003). In the second stage, the platform firm creates boundary resources, i.e., APIs and SDKs, which require formative input and

Table 3 Classification of DPE emergence stages

Pivotal aspect	Digital platform formation	Boundary resource creation	Complementor integration	Ecosystem orchestration
Platform architecture	Monolithic or modular	Modular	Modular	Modular
Capabilities	Innovation	Innovation, sensing	Innovation, sensing, integrative	Innovation, sensing, integrative, orchestration
Competition	Platform-level	Platform-level	Platform-level	Ecosystem-level
Generativity	Platform owner driven	Platform owner driven	Platform owner driven	Complementor driven
Governance	Platform-level	Platform-level	Platform-level, ecosystem-level	Platform-level, ecosystem-level
Value-creation	Market efficiency and power, pricing structure, network effects	Market efficiency and power, pricing structure, network effects	Market efficiency and power, pricing structure, network effects, knowledge management	Market efficiency and power, pricing structure, network effects, knowledge management, flexibility, cost savings
Key activities	Locate a business opportunity and attract users based on network effects	Define own platform standards or adapt industry standards	Attract and enable complementors	Harmonize offerings and maintain quality throughout the ecosystem

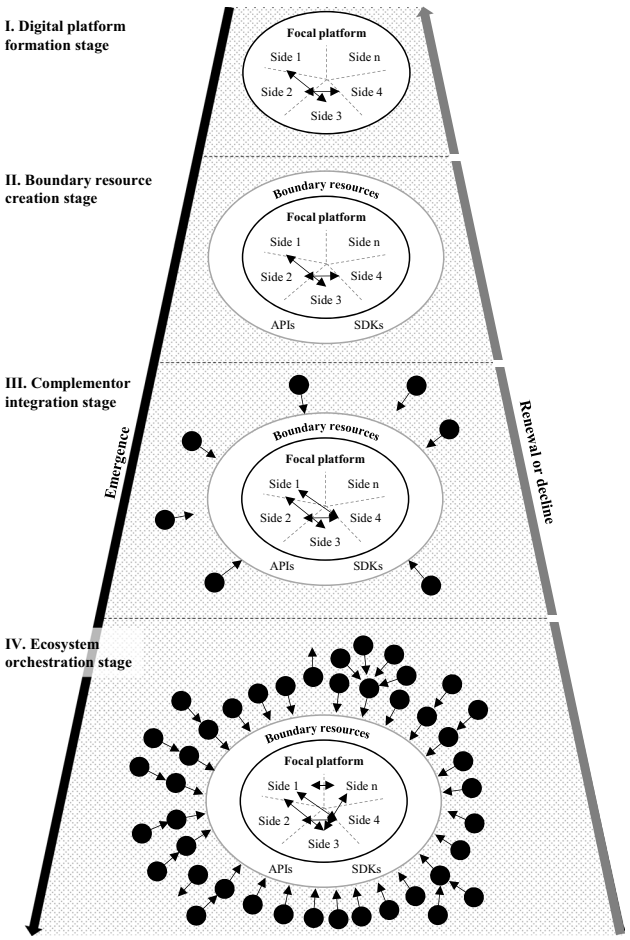

Fig. 1 Digital platform ecosystem flux

determine the guidelines for future complementor interaction. These interactions are often subject to standards, which can be either industry-induced or defined by the focal platform firm itself (Jones et al., 2021; McIntyre & Srinivasan, 2017). Boundary resources rely on a suitable platform architecture (Cennamo et al., 2018; Tiwana, 2014) enabling future complementors to re-use components and to generate additional value. Followed by the creation of boundary resources, in the third stage, complementors can be attracted and integrated, resulting in the formation of the surrounding ecosystem. In this stage, the focal platform firm must ensure that complementors are enabled to.contribute to the platforms' offering. Subsequently, in the fourth stage, the focal platform firm starts to orchestrate the entire ecosystem, fostering value co-creation with complementors and enforcing governance principles. In this stage, the firm must harmonize the offering of numerous complementors and assure their quality. After emergence is concluded, the DPE is orchestrated and maneuvered through phases of technological change (Ozalp et al., 2018), sustaining its competitive position against other ecosystems or powerful complementors within its own ecosystem (Zhu & Liu, 2018).

However, in certain situations the progression into a comprehensive DPE is not viable or desired. Examples can be found for platforms in the defense industry, in which boundary resources would be exposed to security concerns, or focal firms aim to incorporate all functionalities within their platform, making complementary products infeasible. Likewise, progress may be hindered, if the focal platform firm cannot execute key activities in each stage in a satisfactory manner.

A DPE may ultimately enter a stage of strategic or technological renewal, decline, or obsolescence. Technological progress affects digital infrastructures and architectures, making them less competitive with newer generations. At some point, focal platform firms face the challenge of updating their platform architecture and subsequent technologies (Brunswicker et al., 2019). Depending on the update, the

firm can either update only the boundary resources or the technological foundation of the whole platform. In either case, the subsequent stages of the DPE flux are likely to be shorter than the first cycle, because the focal platform firm has already established ties with complementors and acquired integration and orchestration capabilities (Helfat & Raubitschek, 2018). Complementors may, however, seize an opportunity to challenge the focal platform firms' position during the transition (Ozalp et al., 2018). In other situations, the focal platform firm may miss the opportunity to renew, thereby weakening not only its own strategic position but also the strategic position of the entire DPE (Boudreau & Hagiu, 2009). However, a detailed analysis of the consequences is beyond the scope of this article.

Digital platform formation stage

The digital platform formation stage is the first stage of DPE emergence. In this stage, the focal platform is created by either a single organization or a consortium of multiple organizations based either on a monolithic or modular platform architecture (Gawer, 2014). Various groups of users then engage in interactions facilitated by the platform. Literature dealing with the digital platform formation stage focuses primarily on competition in two-sided markets (Rochet & Tirole, 2003), network effects, and the chicken and egg problem. Illustrative examples are located within the video game industry and the credit card industry (Belleflamme & Toulemonde, 2009; Eisenmann et al., 2006).

Researchers start identifying the relevance of a firms' dynamic capabilities in the context of digital platforms (Helfat & Raubitschek, 2018). In the digital platform formation stage, innovation capabilities consisting of coordinating, learning, reconfiguring, and new product development capabilities are of particular importance. Digital platforms usually incorporate new technologies, leading to a competitive advantage (Belleflamme & Peitz, 2019; Belleflamme & Toulemonde, 2009; Cennamo & Santaló, 2013). With several exceptions, however, it remains unclear how dynamic capabilities can be acquired or extended in a digital platform setting, calling for further empirical studies (Tan et al., 2015).

While conventional inter-firm competition focuses on moves and counter-moves as strategic actions that enable rivaling firms to capture greater shares of a given market value, platform competition reshapes markets as a whole (Rochet & Tirole, 2003). Platforms alter how customers access and utilize products and services by extending their value and functionalities (Cennamo & Santaló, 2019). This concludes either in increasing the market size or even in creating entirely new markets. Researchers also investigated how platforms use price (Parker & van Alstyne, 2005) or subsidizations (Kretschmer & Claussen, 2016) as competitive actions. A competitive advantage in platform markets can be achieved by establishing a strong identity and distinctiveness, making the platform unique. Furthermore, the platform size and control over the market composition, sometimes called market architecture, comprises sources of competitive advantage (Cennamo, 2021).

Platform governance consists of ground rules that regulate interactions either within one side or between multiple sides of a digital platform (Cusumano & Gawer, 2002), balancing different interests (Darking et al., 2008). Tiwana (2014) describes platform governance as a composition of the three dimensions decision rights, control mechanisms, and pricing policies. Furthermore, the degree of openness determines not only how easy it is for either new users to join the platform or to decide if potential new sides should be added to the platform, but also how the sides interact with each other (Hagiu, 2014).

Researchers assume that network effects can be either present or absent and successful platform formation may only be possible in case they are present. This dichotomous view is, however, beginning to change as a result of findings from recent studies that introduce distinct antecedents and mechanisms of network effects. Studies argue that network effects can, to a certain extent, be created or altered in favor of firms, and counters the pre-dominant view of treating them as exogenous industry attributes (McIntyre & Srinivasan, 2017; McIntyre & Subramaniam, 2009).

Key activities

In many platforms, at least one side of the platform must be subsidized to overcome the chicken and egg problem (Caillaud & Jullien, 2003; Hagiu, 2006) and enable growth and subsequent adoption on the other side. A prominent example is, again, video game consoles. In this example, the focal platform firm usually develops and manufactures the hardware. To attract the other sides of the platform, i.e., end users and game developers, the hardware side is subsidized, making it more appealing to end users to join the platform. At a certain point, the adoption rate on one side reaches its tipping point, resulting in the adoption of users on other sides of the platform to skyrocket (Song et al., 2018; Tiwana, 2014). While this phenomenon has been mostly researched in the context of video game consoles, it remains unclear whether subsidizing one side of the platform is the only possibility to overcome the chicken and egg problem. Furthermore, video game consoles usually still subsidize one side of the platform, even if adoption on the other side has already skyrocketed. Few studies, i.e., Cennamo et al. (2018) and Kretschmer and Claussen (2016) try to explain what happens to adoption if subsidies are cut or if there are other means than pricing to be implemented.

Boundary resource creation stage

As a prerequisite to reach the second stage of DPE emergence, the focal platform owner has to create boundary resources to enable future complementor integration (Ghazawneh & Henfridsson, 2013). Boundary resource research is a more focused area than the dynamics of platforms and ecosystems (Ghazawneh & Henfridsson, 2015). Research deals with boundary resources' design (Eaton et al., 2015), standards (Teece, 2018), and protection against exploitation (Karhu et al., 2018).

A modular platform architecture defining technological interactions between actors is a fundamental prerequisite to enable complementor integration (Kapoor, 2018). Architecture is defined as the purpose and interaction of an underlying set of technologies to create a conceptual blueprint. This accounts for the property rights of individual apps and how they interact with each other and with the platform itself. Architectural choices are fundamental and almost irreversible in practice (Tiwana, 2014; Tiwana et al., 2010). However, these decisions have a significant impact on DPE emergence. Boundary resources must be ready before the first complementor is integrated into the ecosystem. Decisions on architecture must therefore be made in a short time, and mistakes can turn out to be dramatic (Karhu et al., 2018; Nambisan et al., 2019). The platforms' architecture consequently determines market potentials prior to advancing into the following stages (Saadatmand et al., 2019).

A modular platform architecture separates platform from complement development and enables complements being combined without restrictions or negative impacts on stability, functionality, or performance (Hein et al., 2020; Saadatmand et al., 2019). As a result, design dependencies in the development process are reduced and changes or updates of complements do not affect the others. When creating boundary resources, the focal platform owner must decide which components are inherent to the platform and which better remain outside of the platform. Usually, highly reusable or generic methods and routines are essential to the platform and can be easily adopted by complementors. The same logic applies to platform interfaces and stable functionality. Uncertain or special purpose functionality should, however, remain outside of the platforms' core functionality (Tiwana, 2014).

Successful boundary resource creation requires sensing capabilities. The focal platform firms' ability to sense and predict new platform opportunities represents a crucial input to decide what boundary resources must be added to the platform. Sensing capabilities enable firms to identify new or untapped technologies and indicate market potentials. Sensing capabilities are strongly connected with underlying mental processes of attention and perception on the level of an individual. While the mental process of attention enables the individual to be highly aware of opportunities and threats in the environment the individual pays attention to, the mental process of perception allows the individual to extract and interpret emerging patterns from unstructured data (Helfat & Martin, 2015; Helfat & Peteraf, 2015; Helfat & Raubitschek, 2018). With this information boundary, resources are shaped to act as barriers for future competitors and to secure the lock-in of strategic complementors.

Key activities

Design and specifications of APIs and SDKs as manifestations of boundary resources are highly dependent on the context of the digital platform, and their creation may subsequently even create entirely new digital services, products, and ecosystems (Evans & Schmalensee, 2016). Nevertheless, scholars argue that the focal platform owner has to put emphasis on the user-friendliness of future complements during their development (Penttinen et al., 2018). Considering standards is, however, more challenging. On the one hand, standards form the technical environment of platform development and safeguard complement compatibility. Already in this stage, platform leaders often define their own standards to become standards for the entire future ecosystem or the entire industry. Open standards foster higher levels of complementor participation, potentially leading to a greater variety of complements. Proprietary standards, however, give the focal platform firm more control and may act as entry barriers for future complementors and competitors (McIntyre & Srinivasan, 2017). On the other hand, focal platform firms are often exposed to present industry standards to which their platform must comply.

An illustrative example of the boundary resource creation stage is Sony's PlayStation 5 prior to its market release. Sony as the focal platform firm faces the challenge to form its digital platform, create boundary resources, and integrate complementors before the device is released. The particular challenge is to make these decisions without direct customer feedback, which imposes a high risk of failure. If successful, the PlayStation 5 is, however, expected to evolve into the subsequent complementor orchestration stage in a short time.

Complementor integration stage

In the third stage, platform firms are concerned with attracting the first complementors to form the surrounding ecosystem. Research on complementor integration covers various aspects. Particularly well researched is the multihoming effect causing complementors to engage in multiple ecosystems (Cennamo & Santaló, 2013; Koh & Fichman, 2014; McIntyre & Srinivasan, 2017). Furthermore, a large body of studies investigated how interactions between the focal

platform firm and complementors are governed (Saadatmand et al., 2019; Wareham et al., 2014; Zhang et al., 2022). From an emergence perspective, it is, however, less researched how the chicken and egg problem for the ecosystem is overcome in the sense of attracting the first complementors to make the ecosystem attractive to further joiners.

Integrative capabilities in a DPE context expand the scope from solely examining the focal platform firm to the entire ecosystem. These integrative capabilities support interactions and relationships between the focal platform firm and complementors, enabling the alignment of activities, products, services, and resources, as well as firm internal coordination. This alignment is of particular importance for a DPE's success, since success and failure depend not only on actions of the focal platform firm but also on the surrounding complementor ecosystem (Helfat & Raubitschek, 2018).

While platform governance focuses on the interactions within a single user group or between different user groups, ecosystem governance regulates interactions both between complementors and between complementors and the focal platform firm. This contains ownership, decision rights, control mechanisms, service levels, pricing structures, and penalties for misbehavior (Tiwana, 2014). A central aspect of ecosystem governance is the ownership of the focal platform. Ownership decisions affect both the distribution of power and the relationships between actors in the ecosystem, leading to a vertical, horizontal, or modular system. Vertical ecosystems are represented by a high core-extension coupling and allocated decision rights at a single actor that mediates the relationship between the actors within the ecosystem. In contrast, a horizontal ecosystem is based on a low core-extension coupling and power is distributed among complementors. Modular ecosystems consist of parallel configurations embracing different forms (Bakos & Katsamakas, 2008; Saadatmand et al., 2019; Tiwana et al., 2010).

Multihoming of either platform user groups or complementors may occur, leading to the participation in more than one platform ecosystem (Tiwana, 2014). While multihoming of end users is highly related to the DPE offerings, multihoming of complementors depends on competition. Particularly in markets with high platform competition, complementors seek to reach out to the entire end user population by offering their products and services to multiple platforms (Corts & Lederman, 2009). Consequently, DPEs are likely to consist of a mix of complementors either being exclusively engaged or seeking to multi-home in competing ecosystems to boost sales (Cennamo & Santaló, 2019). Well-known examples are credit cards. Since multihoming costs are low in this industry, most users have multiple cards from different payment services, such as Visa and Mastercard, making them participate in both ecosystems. The same mechanism applies to app developers developing apps for both the iOS and Android platform, making them also part of their surrounding ecosystems.

Furthermore, the focal platform owner can deploy knowledge management efforts to establish an information base for potential complementors and enhance collaboration. Knowledge management within DPEs is of particular relevance to achieve innovation leverage and create economies of scope from component reuse (Gawer, 2014). Focal platform firms have several possibilities to exchange knowledge with complementors. One possibility is the standardized broadcasting of information via transferable objects, i.e., handbooks or guidelines, or wikis. Complementors can access this knowledge without direct interaction with the focal platform firm. Second, knowledge brokering provides meta-knowledge and takes place for a subset of complementors via dedicated and semi-formalized interaction, i.e., helpdesks and account managers. Third, knowledge bridging targets an individual complementor with specific knowledge transfers, i.e., one-to-one assistance and coaching (Foerderer et al., 2019; Huang et al., 2018; Zhang et al., 2022).

Key activities

After boundary resources have been created, complementors must be attracted to the platform to foster ecosystem generation (Adner, 2017). Like the chicken and egg problem for platforms, whether it is about challenging the focal platform firm to attract a certain user base on one side of the platform or whether it is about encouraging users on other sides to adopt the platform, there is a similar challenge that forms the surrounding ecosystem. In many cases, complementors lack a solid information base, which makes it more difficult to evaluate collaborations with potential ecosystems (Dattée et al., 2018). Particularly for emerging or fast-changing DPEs, the information base may be vague or non-existent (Hannah & Eisenhardt, 2018). The integration of complementors leads to additional platform offerings. These new offerings may even attract completely new groups of users to the platform, which then interact with other sides on the platform (Boudreau, 2012). As a consequence, the platform adds new sides to its offering increasing the overall transactions and, in many cases, the platform value. This effect is also illustrated in Fig. 1.

Temporary gatherings are a possibility to overcome the information deficit between focal platform firms and potential complementors. An example of temporary gatherings is hackathons where developers meet either physically or virtually and create applications in a certain timeframe. This gives focal platform firms the chance to act as sponsors and convince complementors of their technologies and strategies. Fang et al. (2021) provide empirical evidence that temporary gatherings foster social

learning knowledge exchange as well as coordination around an emerging technology. A striking example of the positive impact of temporal gatherings is Apple's Worldwide Developers Conference, fostering collaboration and generativity between complementors (Foerderer, 2020).

DPEs cope with high product or service complexity by successful complementor integration and ecosystem expansion. Nambisan and Sawhney (2011) argue that successful integration relies on successful management of modularity, network stability, knowledge, as well as innovation appropriability, coherence, and leverage. Complexity is arguably higher in the context of enterprise software due to a broader range of functionalities, architectures, and interfaces. In contrast, consumer software generally covers a narrower set of functionalities (Foerderer et al., 2019; Ghazawneh & Henfridsson, 2013). Higher product and service complexity represent a challenge for the focal platform firm to integrate complementors that are capable to cope with sophisticated requirements of enterprise clients. While downtimes of digital services are usually not critical to consumers, processes in enterprises critically depend on continuous availability of IT resources and services. As a result, complementors can be made reliable for service-level agreements demanding hotfixes and support according to customer needs.

Ecosystem orchestration stage

Platform firms reach the fourth stage after the successful integration of complementors (Nambisan & Sawhney, 2011). Since the value proposition of DPEs is based on a mix-and-match customization, which builds on a general component that fulfills the need of an average customer combined with specialized components tailored to specific needs of certain customers, complementors move into the locus of attention (Tiwana, 2014).

Throughout the fourth stage, the focal platform owner requires strong orchestration capabilities to maintain governance principles as well as an adequate level of openness. While a too closely governed DPE may reduce attractiveness for complementors, too open DPEs may be vulnerable to strategic exploitation (Karhu et al., 2018). In many cases, the focal platform firm does, however, demonstrate goodwill toward complementors (Sarker et al., 2012). To further increase attractiveness for certain complementors, the focal platform firm can apply selective promotion to boost visibility of promoted complements (Rietveld et al., 2019). On the other hand, complementors may seek to influence strategic decisions of focal platform firms over time (Hein et al., 2020; Huber et al., 2017). In case of feared non-compliance with established governance principles, focal platform firms are forced to react. A recent example is the banning of the game Fortnite from the Apple App Store over a dispute concerning the distribution of profits.

Ecosystem competition directly influences the degree to which a complementor identifies with shared values and goals or pursues its own agenda across multiple ecosystems (Cennamo & Santaló, 2019; Wareham et al., 2014). Especially during phases of significant technological change, the interplay between the focal platform firm and its complementors highly affects its strategic position against competing ecosystems. In these phases, boundary resources have to be updated and improved, fundamentally incorporating new technologies. In industries with longer product lifecycles, such as video game consoles, transitions between technological generations may even imply complete obsolescence of previous complements. During transitions, incumbents may see their once dominant market positions topple, opening the doors for both other ecosystems to challenge their market positions and complementors to turn into direct competitors (Ozalp et al., 2018; Zhu & Liu, 2018).

DPEs offer complementors access to markets that would not have been accessible for them acting as standalone vendors. This is achieved by building on modularity and loose ties for value creation and delivery (Nambisan et al., 2019), changing the view from traditional inter-firm competition toward coopetition, i.e., a simultaneous competition and cooperation (Hein et al., 2019b). The value of DPEs is determined not only by the quality of individual complements but also by interactions between complementors (Adner & Kapoor, 2010; Rietveld et al., 2019). When competition is strong within the ecosystem, complementors might crowd out and prefer to join DPEs with less competition and higher odds to monetize their products (Boudreau, 2012). To counter this development, the focal platform firm should instead encourage cooperation by investing in long-term relations (Zhang et al., 2022).

Further central DPE governance aspects are the application review time and the platform updating frequency (Song et al., 2018). The application review time determines the temporal lag for complements until they are made available to users. During the review, the focal platform firm wants to make sure that the complement complies with platform requirements and governance principles. Review times affect complementors' internal development processes and schedules as well as users' waiting times until new features or bug fixes are released. In contrast, the platform updating frequency determines how often the focal platform itself is enriched with new features or bug fixes. If new technologies that are not compatible with their predecessors are introduced, updates may affect all sides of the platform as well as complements.

Key activities

Together with ownership and the distribution of decision rights, property rights play an important role in

complementors' decisions to partner with the focal platform owner and to join the ecosystem (Huang et al., 2013). Especially in the context of digital piracy, the unauthorized copying and distribution of digital products may cause severe damage to DPEs, diminishing overall revenues and hindering innovation (Miric & Jeppesen, 2020). Strong and enforceable property rights are, however, a measure to lower piracy risks by providing firms with exclusive control over created technologies. Empirical evidence on the impact of piracy on DPEs is, however, limited due to considerable discretion in terms of the focal platform firms' government actions. As one of the few examples, Boudreau and Hagiu (2009) present insights from the video game industry that led to the downfall of Atari. Poor policies encouraged copycats to swamp the market with low-quality video games, causing the ecosystem to collapse. In other empirical cases, uncontrolled entry of low-quality complementors caused a negative effect on the ecosystems' overall innovation output (Boudreau, 2012; Miric & Jeppesen, 2020). The focal platform firm therefore has to constantly assure the quality that complementors offer, and harmonize the offerings as a whole.

Complementors have often been treated as black boxes, with only a few studies investigating the internal dynamics of complementors (Tiwana, 2018). However, for creating complex products and services, complementors may engage with other firms. These complementors act as sub-complementors representing additional layers to the ecosystem without directly interacting with the focal platform firm. This leads to an onion analogy, with multiple layers incorporating dynamics that are currently not in the scope of most researchers.

Discussion and conclusion

DPE emergence consists of four distinct stages starting from the creation of a digital platform and concluding in a platform firm orchestrating an ecosystem that contains numerous complementors. During digital platform formation, the focal platform firm focuses on establishing a platform-based product or service, creating fundamental technologies, and attracting users on various sides of the platform (Caillaud & Jullien, 2003; Hagiu, 2006). To further increase customer value, the firm creates boundary resources aiming to attract third-party complementors. Boundary resources rely on a suitable platform architecture (Cennamo et al., 2018; Tiwana, 2014) and standards (McIntyre & Srinivasan, 2017) enabling future complementors to reuse components and to generate additional value. With boundary resources in place, the focal platform firm integrates complementors and enforces governance mechanisms (Wareham et al., 2014). Emergence is concluded by the focal platform firm orchestrating the DPE. The firm then maneuvers the DPE through phases of technological change (Ozalp et al., 2018) to sustain its competitive position against other ecosystems or powerful complementors within its own ecosystem (Zhu & Liu, 2018).

With this article, we contribute to the ongoing discussion about the emergence of DPEs. First, we present four research perspectives dealing with digital platforms, with each perspective contributing to our understanding of DPEs. Second, the four-staged framework and the related stage classification help both researchers and managers to account for shifts in required capabilities, competition, governance, and value creation along DPE emergence. Third, certain key activities must be performed in each stage to enable the transition from a nascent digital platform to a wide-spanning DPE.

For conceptualizing DPE emergence, we have limited this article to proprietary platforms where the focal platform firm makes fundamental architectural and governance decisions prior to engaging complementors. Shared platforms are, however, owned by a consortium or a peer-to-peer community (Hein et al., 2020) and may show different key activities in each stage or even an entirely different emergence pattern. There are further anomalies affecting DPE emergence. For instance, it may be the case that the focal platform firm does not manage to attract enough users on the platform to overcome the chicken and egg problem. In such a case the digital platform would remain in the first stage, before declining or ending in obsolescence. It may also be the case that the focal platform firm does not manage to make complementor participation viable, and therefore does not reach the fourth stage. Platform-markets are also prone to consolidation and winner-take-all dynamics. A major actor may purchase rival digital platforms or drive them out of the market. In these cases, valuable complementors are often transferred to the dominant platform, while other platforms end in obsolescence. There are manifold examples in the food delivery or ride hailing industry (Garud et al., 2022). In addition, there may be instances where deliberate management decisions have impacted emergence and resulted in alternative stages. Examples are digital platforms that incorporate a monolithic platform architecture composing all elements together and limiting external impact (Tiwana, 2014), DPEs orchestrated by government bodies (Addo, 2022) or geographical resistance against a DPE (Carrasco-Farré et al., 2022). Despite the anomalies successful DPE emergence eventually concludes in the ecosystem orchestration stage, utilizing a digital platform, boundary resources, and complementors. At a certain point in time, DPEs may, however, enter a stage of strategic renewal,decline, or even obsolescence. These stages are expected to be induced from significant technological change (Cennamo, 2018; Ozalp et al., 2018)

Table 4 Digital platform ecosystem research agenda

Aspect	Avenue for future research
Emergence of shared platforms	Shared platforms are substantially less researched than proprietary platforms (Tiwana, 2014). It is expected that they show a different emergence compared to proprietary platforms since they often originate from already existing communities. In a more recent study Lee et al. (2018) outline the need for further studies to determine emergence of shared market infrastructures
DPE decline and obsolescence	Like other digital products and infrastructures, DPEs are expected to decline and reach their technological obsolescence at a certain point in time. Apart from Ozalp et al. (2018), relatively little is known about the underlying strategic actions required to manage such transitions
Network effects	McIntyre and Srinivasan (2017) outline that network effects can be manipulated in a firms' favor. There is, however, a lack of comprehensive frameworks describing the implications of these strategic actions and a lack of empirical evidence
Platform-based business models	Boudreau and Lakhani (2009) present three distinct platform-based business models. There are, however, only a few empirical studies investigating how incumbents successfully transform their pipeline business models into platform-based business models (Evans & Schmalensee, 2016). More recent studies still emphasize the need for additional platform-based business model research (Cennamo, 2021)
Sub-complementor engagement and coopetition	Complex platform-based products and services often require complementors to engage with other complementors, making them contribute to the overall value proposition. These interactions follow the notion of coopetition but remain little researched overall (Hein et al., 2019b)
Complementor exit and re-positioning	In certain situations, complementors can be pushed out of a DPE or deliberately choose to leave it (Zhu & Liu, 2018). We lack insights on the prospects and strategic re-positioning of such complementors
DPEs as boundaryless organizations	Complementors often become integral parts of the DPE's common value proposition, making the boundaries between physical organizations fade. In academia, there are substantial shortcomings in investigating new platform-based organizational forms and knowledge transfers in such constructs (Kretschmer et al., 2022)
Complementor influence	Cennamo (2021) and Hein et al. (2020) outline the impact key complementors have on the focal platform firms' strategic decisions. However, studies that empirically confirm previous theoretical assumptions remain scarce
Capabilities	Helfat and Raubitschek (2018) bridge the perspective of dynamic capabilities with DPEs. There is, however, a need for further research in determining industry-depending frameworks and empirical confirmation (Thomas et al., 2014)
Insights from other research domains	Research on digital platforms and ecosystems is not limited to the management and information science literature. Integrating views from the marketing literature (Perren & Kozinets, 2018) may open various avenues for future research
DPE emergence from supply-chain platforms and in non-manufacturing industries	DPE emergence is mainly researched in the areas of manufacturing (Sandberg et al., 2020; Stonig et al., 2022) and digital marketplaces (Tan et al., 2015; Zhu & Liu, 2018). There is, however, a lack of studies investigating how platforms in other supply-chains transition into DPEs. Further, there is a lack of evidence for DPE emergence in other industries such as insurance

or through a loss in profitability or growth opportunities (Zhu & Liu, 2018). These aspects are not in the scope of this article but may, however, deliver valuable insights for future studies.

While researchers have made a lot of progress in investigating platforms as digital infrastructures (Gawer, 2014), the concept of ecosystems is still relatively new (Kapoor, 2018). Table 4 lists major avenues for promising future research to obtain a better understanding of DPE dynamics and implications. In addition to the table we elaborate on the most promising avenues in more detail. Overall, there is a re-occurring pattern of lacking in-depth longitudinal empirical evidence to confirm theoretical assumptions (Jha et al., 2016; Saadatmand et al., 2019). Furthermore, it becomes evident that complementors not only contribute to the focal platform firms' value proposition, but also actively shape the entire DPE through their actions (Hein et al., 2020).

Scholars outline promising paths to further investigate antecedents, drivers, and mechanisms leading to the formation of network effects across various industries (McIntyre & Srinivasan, 2017). Research on network effects and the chicken and egg problem has primarily focused on the video game industry. In other settings, it appears promising

to investigate what means other than pricing can be used to subsidize one or multiple sides of a multi-sided platform. For instance, we anticipate that an exclusive or early access to specific content may have a positive impact on participation on preferred sides of the platform.

Scholars often treat complementors as black boxes, and the complementors' underlying dynamics remain relatively unexplored. Studies should shift their focus to complementors and determine which capabilities are required to participate or actively shape a DPE (Helfat & Raubitschek, 2018). For instance, strong sensing capabilities at complementors may lead to a better anticipation of DPE requirements and therefore better complement quality. Within a DPE, it further appears promising to investigate the strategic actions, based on rivalry, that complementors undertake. With certain strategic actions, dominant complementors may affect the distribution of power in the entire ecosystem, causing leverage over other complementors or even the focal platform firm (Ozalp et al., 2018).

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References

Addo, A. (2022). Orchestrating a digital platform ecosystem to address societal challenges: A robust action perspective. *Journal of Information Technology,* Advance online publication, 1–28. https://doi.org/10.1177/02683962221088333

Adner, R. (2006). Match your innovation strategy to your innovation ecosystem. *Harvard Business Review, 84*(4), 98–107.

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of Management, 43*(1), 39–58. https://doi.org/10.1177/0149206316678451

Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal, 31*(3), 306–333. https://doi.org/10.1002/smj.821

Adner, R., Chen, J., & Zhu, F. (2020). Frenemies in platform markets: Heterogeneous profit foci as drivers of compatibility decisions. *Management Science, 66*(6), 2432–2451. https://doi.org/10.1287/mnsc.2019.3327

Alaimo, C., Kallinikos, J., & Valderrama, E. (2020). Platforms as service ecosystems: Lessons from social media. *Journal of Information Technology, 35*(1), 25–48. https://doi.org/10.1177/0268396219881462

Altman, E. J., Nagle, F., & Tushman, M. L. (2022). The translucent hand of managed ecosystems: Engaging communities for value creation and capture. *Academy of Management Annals, 16*(1), 70–101. https://doi.org/10.5465/annals.2020.0244

Anderson, S. P., & Peitz, M. (2020). Media see-saws: Winners and losers in platform markets. *Journal of Economic Theory, 186*, 104990. https://doi.org/10.1016/j.jet.2019.104990

Armstrong, M. (2006). Competition in two-sided markets. *The RAND Journal of Economics, 37*(3), 668–691. https://doi.org/10.1111/j.1756-2171.2006.tb00037.x

Bai, G., & Velamuri, S. R. (2021). Contextualizing the sharing economy. *Journal of Management Studies, 58*(4), 977–1001. https://doi.org/10.1111/joms.12652

Bakos, Y., & Halaburda, H. (2020). Platform competition with multihoming on both sides: Subsidize or not? *Management Science, 66*(12), 5599–5607. https://doi.org/10.1111/j.1756-2171.2006.tb00037.x

Bakos, Y., & Katsamakas, E. (2008). Design and ownership of two-sided networks: Implications for Internet platforms. *Journal of Management Information Systems, 25*(2), 171–202. https://doi.org/10.2753/mis0742-1222250208

Baldwin, C. Y., & Clark, K. B. (2000). *Design rules: The power of modularity*. MIT Press.

Baldwin, C. Y., & Woodard, C. J. (2009). The architecture of platforms: A unified view. In A. Gawer (Ed.), *Platforms, markets and innovation* (pp. 19–35). Edward Elgar.

Bar-Gill, S. (2019). Game of platforms: Strategic expansion into rival (online) territory. *Journal of the Association for Information Systems, 20*(10), 1475–1503. https://doi.org/10.17705/1jais.00575

Belleflamme, P., & Peitz, M. (2019). Managing competition on a two-sided platform. *Journal of Economics & Management Strategy, 28*(1), 5–22. https://doi.org/10.1111/jems.12311

Belleflamme, P., & Toulemonde, E. (2009). Negative intra-group externalities in two-sided markets. *International Economic Review, 50*(1), 245–272. https://doi.org/10.1111/j.1468-2354.2008.00529.x

Benlian, A., Hilkert, D., & Hess, T. (2015). How open is this platform? The meaning and measurement of platform openness from the complementors' perspective. *Journal of Information Technology, 30*(3), 209–228. https://doi.org/10.1057/jit.2015.6

Bergvall-Kåreborn, B., & Howcroft, D. (2014). Persistent problems and practices in information systems development: A study of mobile applications development and distribution. *Information Systems Journal, 24*(5), 425–444. https://doi.org/10.1111/isj.12036

Bonina, C., Koskinen, K., Eaton, B., & Gawer, A. (2021). Digital platforms for development: Foundations and research agenda. *Information Systems Journal, 31*(6), 869–902. https://doi.org/10.1111/isj.12326

Boudreau, K. J. (2010). Open platform strategies and innovation: Granting access vs. devolving control. *Management Science, 56*(10), 1849–1872. https://doi.org/10.1287/mnsc.1100.1215

Boudreau, K. J. (2012). Let a thousand flowers bloom? An early look at large numbers of software app developers and patterns of innovation. *Organization Science, 23*(5), 1409–1427. https://doi.org/10.1287/orsc.1110.0678

Boudreau, K. J. (2021). Promoting platform takeoff and self-fulfilling expectations: Field experimental evidence. *Management Science, 67*(9), 5953–5967. https://doi.org/10.1287/mnsc.2021.3999

Boudreau, K. J., & Hagiu, A. (2009). Platform rules: Multi-sided platforms as regulators. In A. Gawer (Ed.), *Platforms, markets and innovation* (pp. 163–191). Edward Elgar.

Boudreau, K. J., & Lakhani, K. (2009). How to manage outside innovation. *MIT Sloan Management Review, 50*(4), 69–76.

Bresnahan, T., & Greenstein, S. (2014). Mobile computing: The next platform rivalry. *American Economic Review, 104*(5), 475–480. https://doi.org/10.1257/aer.104.5.475

Breznitz, D., Forman, C., & Wen, W. (2018). The role of venture capital in the formation of a new technological ecosystem: Evidence from the cloud. *MIS Quarterly, 42*(4), 1143–1169. https://doi.org/10.25300/misq/2018/13577

Brunswicker, S., Almirall, E., & Majchrzak, A. (2019). Optimizing and satisficing: The interplay between platform architecture and producers' design strategies for platform performance. *MIS Quarterly, 43*(4), 1249–1277. https://doi.org/10.25300/misq/2019/13561

Caillaud, B., & Jullien, B. (2003). Chicken & egg: Competition among intermediation service providers. *The RAND Journal of Economics, 34*(2), 309–328. https://doi.org/10.2307/1593720

Carrasco-Farré, C., Snihur, Y., Berrone, P., & Ricart, J. E. (2022). The stakeholder value proposition of digital platforms in an urban ecosystem. *Research Policy, 51*(4), 104488. https://doi.org/10.1016/j.respol.2022.104488

Ceccagnoli, M., Forman, C., Huang, P., & Wu, D. J. (2012). Co-creation of value in a platform ecosystem: The case of enterprise software. *MIS Quarterly, 36*(1), 263–289. https://doi.org/10.2307/41410417

Cenamor, J., & Frishammar, J. (2021). Openness in platform ecosystems: Innovation strategies for complementary products. *Research Policy, 50*(1), 104148. https://doi.org/10.1016/j.respol.2020.104148

Cennamo, C. (2018). Building the value of next-generation platforms: The paradox of diminishing returns. *Journal of Management, 44*(8), 3038–3069. https://doi.org/10.1177/0149206316658350

Cennamo, C. (2021). Competing in digital markets: A platform-based perspective. *Academy of Management Perspectives, 35*(2), 265–291. https://doi.org/10.5465/amp.2016.0048

Cennamo, C., & Santaló, J. (2013). Platform competition: Strategic trade-offs in platform markets. *Strategic Management Journal, 34*(11), 1331–1350. https://doi.org/10.1002/smj.2066

Cennamo, C., & Santaló, J. (2019). Generativity tension and value creation in platform ecosystems. *Organization Science, 30*(3), 617–641. https://doi.org/10.1287/orsc.2018.1270

Cennamo, C., Ozalp, H., & Kretschmer, T. (2018). Platform architecture and quality trade-offs of multihoming complements. *Information Systems Research, 29*(2), 461–478. https://doi.org/10.1287/isre.2018.0779

Chan, L. T. (2021). Divide and conquer in two-sided markets: A potential-game approach. *The RAND Journal of Economics, 52*(4), 839–858. https://doi.org/10.1111/1756-2171.12393

Chellappa, R. K., & Mukherjee, R. (2021). Platform preannouncement strategies: The strategic role of information in two-sided markets competition. *Management Science, 67*(3), 1527–1545. https://doi.org/10.1287/mnsc.2020.3606

Chen, T., Qian, L., & Narayanan, V. (2017). Battle on the wrong field? Entrant type, dominant designs, and technology exit. *Strategic Management Journal, 38*(13), 2579–2598. https://doi.org/10.1002/smj.2669

Chen, L., Tong, T. W., Tang, S., & Han, N. (2022). Governance and design of digital platforms: A review and future research directions on a meta-organization. *Journal of Management, 48*(1), 147–184. https://doi.org/10.1177/01492063211045023

Ciborra, C. U. (1996). The platform organization: Recombining strategies, structures, and surprises. *Organization Science, 7*(2), 103–118. https://doi.org/10.1287/orsc.7.2.103

Claussen, J., & Halbinger, M. A. (2021). The role of pre-innovation platform activity for diffusion success: Evidence from consumer innovations on a 3D printing platform. *Research Policy, 50*(8), 103943. https://doi.org/10.1016/j.respol.2020.103943

Clements, M. T., & Ohashi, H. (2005). Indirect network effects and the product cycle: Video games in the US, 1994–2002. *Journal of Industrial Economics, 53*(4), 515–542. https://doi.org/10.1111/j.1467-6451.2005.00268.x

Cloutier, C., & Langley, A. (2020). What makes a process theoretical contribution? *Organization Theory, 1*(1), 1–32. https://doi.org/10.1177/2631787720902473

Corts, K. S., & Lederman, M. (2009). Software exclusivity and the scope of indirect network effects in the US home video game market. *International Journal of Industrial Organization, 27*(2), 121–136. https://doi.org/10.1016/j.ijindorg.2008.08.002

Cozzolino, A., Verona, G., & Rothaermel, F. T. (2018). Unpacking the disruption process: New technology, business models, and incumbent adaptation. *Journal of Management Studies, 55*(7), 1166–1202. https://doi.org/10.1111/joms.12352

Cusumano, M. (2010). Technology strategy and management: The evolution of platform thinking. *Communications of the ACM, 53*(1), 32–34. https://doi.org/10.1145/1629175.1629189

Cusumano, M. A., & Gawer, A. (2002). The elements of platform leadership. *MIT Sloan Management Review, 43*(3), 51–58.

Cutolo, D., & Kenney, M. (2021). Platform-dependent entrepreneurs: Power asymmetries, risks, and strategies in the platform economy. *Academy of Management Perspectives, 35*(4), 584–605. https://doi.org/10.5465/amp.2019.0103

Darking, M., Whitley, E. A., & Dini, P. (2008). Governing diversity in the digital ecosystem. *Communications of the ACM, 51*(10), 137–140. https://doi.org/10.1145/1400181.1400211

Dattée, B., Alexy, O., & Autio, E. (2018). Maneuvering in poor visibility: How firms play the ecosystem game when uncertainty is high. *Academy of Management Journal, 61*(2), 466–498. https://doi.org/10.5465/amj.2015.0869

de Reuver, M., Sørensen, C., & Basole, R. C. (2018). The digital platform: A research agenda. *Journal of Information Technology, 33*(2), 124–135. https://doi.org/10.1057/s41265-016-0033-3

Dinerstein, M., Einav, L., Levin, J., & Sundaresan, N. (2018). Consumer price search and platform design in internet commerce. *American Economic Review, 108*(7), 1820–1859. https://doi.org/10.1257/aer.20171218

Dou, Y., & Wu, D. J. (2021). Platform competition under network effects: Piggybacking and optimal subsidization. *Information Systems Research, 32*(3), 820–835. https://doi.org/10.1287/isre.2021.1017

Dunn, B., Jensen, M. L., & Ralston, R. (2021). Attribution of responsibility after failures within platform ecosystems. *Journal of Management Information Systems, 38*(2), 546–570. https://doi.org/10.1080/07421222.2021.1912937

Eaton, B., Elaluf-Calderwood, S., Sørensen, C., & Yoo, Y. (2015). Distributed tuning of boundary resources: The case of Apple's iOS service system. *MIS Quarterly, 39*(1), 217–243. https://doi.org/10.25300/misq/2015/39.1.10

Eisenmann, T., Parker, G., & van Alstyne, M. W. (2006). Strategies for two-sided markets. *Harvard Business Review, 84*(10), 92–101.

Elsbach, K. D., & van Knippenberg, D. (2020). Creating high-impact literature reviews: An argument for 'integrative reviews.' *Journal of Management Studies, 57*(6), 1277–1289. https://doi.org/10.1111/joms.12581

Evans, D. S. (2003). Some empirical aspects of multi-sided platform industries. *Review of Network Economics, 2*(3), 191–209. https://doi.org/10.2202/1446-9022.1026

Evans, P. C., & Basole, R. C. (2016). Revealing the API ecosystem and enterprise strategy via visual analytics. *Communications of the ACM, 59*(2), 26–28. https://doi.org/10.1145/2856447

Evans, D. S., & Schmalensee, R. (2016). *Matchmakers: The new economics of multisided platforms*. Harvard Business Review Press.

Fang, T. P., Wu, A., & Clough, D. R. (2021). Platform diffusion at temporary gatherings: Social coordination and ecosystem emergence. *Strategic Management Journal, 42*(2), 233–272. https://doi.org/10.1002/smj.3230

Feng, H., Jiang, Z., Li, M., & Feng, N. (2020). First- or second-mover advantage? The case of IT-enabled platform markets. *MIS Quarterly, 44*(3), 1107–1141. https://doi.org/10.25300/misq/2020/15273

Floetgen, R. J., Strauss, J., Weking, J., Hein, A., Urmetzer, F., Böhm, M., & Krcmar, H. (2021). Introducing platform ecosystem resilience: Leveraging mobility platforms and their ecosystems for the new normal during COVID-19. *European Journal of Information Systems, 30*(3), 304–321. https://doi.org/10.1080/0960085X.2021.1884009

Foerderer, J. (2020). Interfirm exchange and innovation in platform ecosystems: Evidence from Apple's worldwide developers conference. *Management Science, 66*(10), 4772–4787. https://doi.org/10.1287/mnsc.2019.3425

Foerderer, J., Kude, T., Schuetz, S. W., & Heinzl, A. (2019). Knowledge boundaries in enterprise software platform development: Antecedents and consequences for platform governance. *Information Systems Journal, 29*(1), 119–144. https://doi.org/10.1111/isj.12186

Gal-Or, E., & Shi, Q. (2022). Designing entry strategies for subscription platforms. *Management Science, Advance Online Publication.* https://doi.org/10.1287/mnsc.2021.4251

Gao, M. (2018). Platform pricing in mixed two-sided markets. *International Economic Review, 59*(3), 1103–1129. https://doi.org/10.1111/iere.12298

Garud, R., Kumaraswamy, A., Roberts, A., & Le, Xu. (2022). Liminal movement by digital platform-based sharing economy ventures: The case of Uber Technologies. *Strategic Management Journal, 43*(3), 447–475. https://doi.org/10.1002/smj.3148

Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy, 43*(7), 1239–1249. https://doi.org/10.1016/j.respol.2014.03.006

Gawer, A., & Cusumano, M. A. (2008). Platform leaders. *MIT Sloan Management Review, 49*(2), 68–75.

Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management, 31*(3), 417–433. https://doi.org/10.1111/jpim.12105

Gawer, A., & Phillips, N. (2013). Institutional work as logics shift: The case of Intel's transformation to platform leader. *Organization Studies, 34*(8), 1035–1071. https://doi.org/10.1177/0170840613492071

Gerwe, O., & Silva, R. (2020). Clarifying the sharing economy: Conceptualization, Typology, antecedents, and effects. *Academy of Management Perspectives, 34*(1), 65–96. https://doi.org/10.5465/amp.2017.0010

Ghazawneh, A., & Henfridsson, O. (2013). Balancing platform control and external contribution in third-party development: The boundary resources model. *Information Systems Journal, 23*(2), 173–192. https://doi.org/10.1111/j.1365-2575.2012.00406.x

Ghazawneh, A., & Henfridsson, O. (2015). A paradigmatic analysis of digital application marketplaces. *Journal of Information Technology, 30*(3), 198–208. https://doi.org/10.1057/jit.2015.16

Gomes, R. (2014). Optimal auction design in two-sided markets. *The RAND Journal of Economics, 45*(2), 248–272. https://doi.org/10.1111/1756-2171.12050

Grover, V., & Kohli, R. (2012). Cocreating IT value: New capabilities and metrics for multifirm environments. *MIS Quarterly, 36*(1), 225–232. https://doi.org/10.2307/41410415

Grover, V. (2022). Digital agility: Responding to digital opportunities. *European Journal of Information Systems,* Advance online publication, 1–7. https://doi.org/10.1080/0960085X.2022.2096492

Gupta, S., Jain, D. C., & Sawhney, M. S. (1999). Modeling the evolution of markets with indirect network externalities: An application to digital television. *Marketing Science, 18*(3), 396–416. https://doi.org/10.1287/mksc.18.3.396

Hagiu, A. (2006). Pricing and commitment by two-sided platforms. *The RAND Journal of Economics, 37*(3), 720–737. https://doi.org/10.1111/j.1756-2171.2006.tb00039.x

Hagiu, A. (2014). Strategic decisions for multisided platforms. *MIT Sloan Management Review, 55*(2), 71–80.

Hagiu, A., & Wright, J. (2020). Platforms and the exploration of new products. *Management Science, 66*(4), 1527–1543. https://doi.org/10.1287/mnsc.2018.3272

Hagiu, A., & Yoffie, D. B. (2009). What's your Google strategy? *Harvard Business Review, 87*(4), 74–81.

Hagiu, A., Teh, T.-H., & Wright, J. (2022). Should platforms be allowed to sell on their own marketplaces? *The RAND Journal of Economics, 53*(2), 297–327. https://doi.org/10.1111/1756-2171.12408

Halaburda, H., Jullien, B., & Yehezkel, Y. (2020). Dynamic competition with network externalities: How history matters. *The RAND Journal of Economics, 51*(1), 3–31. https://doi.org/10.1111/1756-2171.12304

Hannah, D. P., & Eisenhardt, K. M. (2018). How firms navigate cooperation and competition in nascent ecosystems. *Strategic Management Journal, 39*(12), 3163–3192. https://doi.org/10.1002/smj.2750

Hänninen, M., & Smedlund, A. (2021). Same old song with a different melody: The paradox of market reach and financial performance on digital platforms. *Journal of Management Studies, 58*(7), 1832–1868. https://doi.org/10.1111/joms.12701

Hein, A., Schreieck, M., Wiesche, M., Böhm, M., & Krcmar, H. (2019a). The emergence of native multi-sided platforms and their influence on incumbents. *Electronic Markets, 29*(4), 631–647. https://doi.org/10.1007/s12525-019-00350-1

Hein, A., Weking, J., Schreieck, M., Wiesche, M., Böhm, M., & Krcmar, H. (2019b). Value co-creation practices in business-to-business platform ecosystems. *Electronic Markets, 29*(3), 503–518. https://doi.org/10.1007/s12525-019-00337-y

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., & Krcmar, H. (2020). Digital platform ecosystems. *Electronic Markets, 30*(1), 87–98. https://doi.org/10.1007/s12525-019-00377-4

Helfat, C. E., & Martin, J. A. (2015). Dynamic managerial capabilities: Review and assessment of managerial impact on strategic change. *Journal of Management, 41*(5), 1281–1312. https://doi.org/10.1177/0149206314561301

Helfat, C. E., & Peteraf, M. A. (2015). Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic Management Journal, 36*(6), 831–850. https://doi.org/10.1002/smj.2247

Helfat, C. E., & Raubitschek, R. S. (2018). Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems. *Research Policy, 47*(8), 1391–1399. https://doi.org/10.1016/j.respol.2018.01.019

Hendel, I., Nevo, A., & Ortalo-Magné, F. (2009). The relative performance of real estate marketing platforms: MLS versus FSBO-Madison.com. *American Economic Review, 99*(5), 1878–1898. https://doi.org/10.1257/aer.99.5.1878

Henderson, R. M., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing. *Administrative Science Quarterly, 35*(1), 9–30. https://doi.org/10.2307/2393549

Hilbolling, S., Berends, H., Deken, F., & Tuertscher, P. (2021). Sustaining complement quality for digital product platforms: A case study of the Philips hue ecosystem. *Journal of Product Innovation Management, 38*(1), 21–48. https://doi.org/10.1111/jpim.12555

Huang, P., Ceccagnoli, M., Forman, C., & Wu, D. J. (2013). Appropriability mechanisms and the platform partnership decision: Evidence from enterprise software. *Management Science, 59*(1), 102–121. https://doi.org/10.1287/mnsc.1120.1618

Huang, P., Tafti, A., & Mithas, S. (2018). Platform sponsor investments and user contributions in knowledge communities: The role of knowledge seeding. *MIS Quarterly, 42*(1), 213–240. https://doi.org/10.25300/misq/2018/13490

Huber, T. L., Kude, T., & Dibbern, J. (2017). Governance practices in platform ecosystems: Navigating tensions between cocreated value and governance costs. *Information Systems Research, 28*(3), 563–584. https://doi.org/10.1287/isre.2017.0701

Hukal, P., Henfridsson, O., Shaikh, M., & Parker, G. (2020). Platform signaling for generating platform content. *MIS Quarterly, 44*(3), 1177–1205. https://doi.org/10.25300/misq/2020/15190

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal, 39*(8), 2255–2276. https://doi.org/10.1002/smj.2904

Jain, R. P., & Ramesh, B. (2015). The roles of contextual elements in post-merger common platform development: An empirical investigation. *European Journal of Information Systems, 24*(2), 159–177. https://doi.org/10.1057/ejis.2014.42

Jeitschko, T. D., & Tremblay, M. J. (2020). Platform competition with endogenous homing. *International Economic Review, 61*(3), 1281–1305. https://doi.org/10.1111/iere.12457

Jha, S. K., Pinsonneault, A., & Dubé, L. (2016). The evolution of an ICT platform-enabled ecosystem for poverty alleviation: The case of eKutir. *MIS Quarterly, 40*(2), 431–445. https://doi.org/10.25300/misq/2016/40.2.08

Jiang, F., Zheng, X., Fan, Di., Zhang, P., & Li, S. (2021). The sharing economy and business model design: A configurational approach. *Journal of Management Studies, 58*(4), 949–976. https://doi.org/10.1111/joms.12711

Jiao, J. R., Simpson, T. W., & Siddique, Z. (2007). Product family design and platform-based product development: A state-of-the-art review. *Journal of Intelligent Manufacturing, 18*(1), 5–29. https://doi.org/10.1007/s10845-007-0003-2

Jones, S. L., Leiponen, A., & Vasudeva, G. (2021). The evolution of cooperation in the face of conflict: Evidence from the innovation ecosystem for mobile telecom standards development. *Strategic Management Journal, 42*(4), 710–740. https://doi.org/10.1002/smj.3244

Jullien, B., & Pavan, A. (2019). Information management and pricing in platform markets. *The Review of Economic Studies, 86*(4), 1666–1703. https://doi.org/10.1093/restud/rdy040

Kapoor, R. (2018). Ecosystems: Broadening the locus of value creation. *Journal of Organization Design, 7*(12), 1–16. https://doi.org/10.1186/s41469-018-0035-4

Kapoor, R., & Agarwal, S. (2017). Sustaining superior performance in business ecosystems: Evidence from application software developers in the iOS and Android smartphone ecosystems. *Organization Science, 28*(3), 531–551. https://doi.org/10.1287/orsc.2017.1122

Karanović, J., Berends, H., & Engel, Y. (2021). Regulated dependence: Platform workers' responses to new forms of organizing. *Journal of Management Studies, 58*(4), 1070–1106. https://doi.org/10.1111/joms.12577

Karhu, K., Gustafsson, R., & Lyytinen, K. (2018). Exploiting and defending open digital platforms with boundary resources: Android's five platform forks. *Information Systems Research, 29*(2), 479–497. https://doi.org/10.1287/isre.2018.0786

Karle, H., Peitz, M., & Reisinger, M. (2020). Segmentation versus agglomeration: Competition between platforms with competitive sellers. *Journal of Political Economy, 128*(6), 2329–2374. https://doi.org/10.1086/705720

Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *American Economic Review,* 75(3), 424–440. https://www.jstor.org/stable/1814809

Katz, M. L., & Shapiro, C. (1986). Technology adoption in the presence of network externalities. *Journal of Political Economy, 94*(4), 822–841. https://doi.org/10.1086/261409

Kazanjian, R. K. (1988). Relation of dominant problems to stages of growth in technology-based new ventures. *Academy of Management Journal, 31*(2), 257–279. https://doi.org/10.5465/256548

Khanagha, S., Ansari, S., Paroutis, S., & Oviedo, L. (2022). Mutualism and the dynamics of new platform creation: A study of Cisco and fog computing. *Strategic Management Journal, 43*(3), 476–506. https://doi.org/10.1002/smj.3147

Koh, T. K., & Fichman, M. (2014). Multihoming users' preferences for two-sided exchange networks. *MIS Quarterly, 38*(4), 977–996. https://doi.org/10.25300/misq/2014/38.4.02

Kretschmer, T., & Claussen, J. (2016). Generational transitions in platform market: The role of backward compatibility. *Strategy Science, 1*(2), 90–104. https://doi.org/10.1287/stsc.2015.0009

Kretschmer, T., Leiponen, A., Schilling, M., & Vasudeva, G. (2022). Platform ecosystems as meta-organizations: Implications for platform strategies. *Strategic Management Journal, 43*(3), 405–424. https://doi.org/10.1002/smj.3250

Kumaraswamy, A., Garud, R., & Ansari, S. (2018). Perspectives on disruptive innovations. *Journal of Management Studies, 55*(7), 1025–1042. https://doi.org/10.1111/joms.12399

Langley, A. (1999). Strategies for theorizing from process data. *Academy of Management Review, 24*(4), 691–710. https://doi.org/10.5465/amr.1999.2553248

Lee, R. S. (2013). Vertical integration and exclusivity in platform and two-sided markets. *American Economic Review, 103*(7), 2960–3000. https://doi.org/10.1257/aer.103.7.2960

Lee, B. H., Struben, J., & Bingham, C. B. (2018). Collective action and market formation: An integrative framework. *Strategic Management Journal, 39*(1), 242–266. https://doi.org/10.1002/smj.2694

Lehdonvirta, V., Kässi, O., Hjorth, I., Barnard, H., & Graham, M. (2019). The global platform economy: A new offshoring institution enabling emerging-economy microproviders. *Journal of Management, 45*(2), 567–599. https://doi.org/10.1177/0149206318786781

Leong, C. M. L., Pan, S. L., Newell, S., & Cui, L. (2016). The emergence of self-organizing e-commerce ecosystems in remote villages of China: A tale of digital empowerment for rural development. *MIS Quarterly, 40*(2), 475–484. https://doi.org/10.25300/misq/2016/40.2.11

Leong, C. M. L., Pan, S. L., Leidner, D. E., & Huang, J.-S. (2019). Platform leadership: Managing boundaries for the network growth of digital platforms. *Journal of the Association for Information Systems, 20*(10), 1531–1565. https://doi.org/10.17705/1jais.00577

Li, H., Zhang, C., & Kettinger, W. (2022). Digital platform ecosystem dynamics: The roles of product scope, innovation, and collaborative network centrality. *MIS Quarterly, 46*(2), 739–770. https://doi.org/10.25300/misq/2022/15444

Li, F. (2021). Sustainable competitive advantages via temporary advantages: Insights from the competition between American and Chinese digital platforms in China. *British Journal of Management,* Advance online publication, 1–24. https://doi.org/10.1111/1467-8551.12558

Llanes, G., & Ruiz-Aliseda, F. (2021). Private contracts in two-sided platforms. *The RAND Journal of Economics, 52*(4), 815–838. https://doi.org/10.1111/1756-2171.12392

Markman, G. D., Lieberman, M., Leiblein, M., Wei, L.-Q., & Wang, Y. (2021). The distinctive domain of the sharing economy: Definitions, value creation, and implications for research. *Journal of Management Studies, 58*(4), 927–948. https://doi.org/10.1111/joms.12707

Marx, P., & Schummer, J. (2021). Revenue from matching platforms. *Theoretical Economics, 16*(3), 799–824. https://doi.org/10.3982/TE3665

McIntyre, D. P., & Srinivasan, A. (2017). Networks, platforms, and strategy: Emerging views and next steps. *Strategic Management Journal, 38*(1), 141–160. https://doi.org/10.1002/smj.2596

McIntyre, D. P., & Subramaniam, M. (2009). Strategy in network industries: A review and research agenda. *Journal of Management, 35*(6), 1494–1517. https://doi.org/10.1177/0149206309346734

Miric, M., & Jeppesen, L. B. (2020). Does piracy lead to product abandonment or stimulate new product development? Evidence from

mobile platform-based developer firms. *Strategic Management Journal, 41*(12), 2155–2184. https://doi.org/10.1002/smj.3208
Miric, M., Pagani, M., & Sawy, O. A. E. (2021). When and who do platform companies acquire? Understanding the role of acquisitions in the growth of platform companies. *MIS Quarterly, 45*(4), 2159–2174. https://doi.org/10.25300/misq/2022/16374
Möhlmann, M., Zalmanson, L., Henfridsson, O., & Gregory, a. R. W. (2021). Algorithmic management of work on online labor platforms: When matching meets control. *MIS Quarterly, 45*(4), 1999–2022. https://doi.org/10.25300/misq/2021/15333
Moore, J. F. (1993). Predators and prey: A new ecology of competition. *Harvard Business Review, 71*(3), 75–86.
Murthy, R. K., & Madhok, A. (2021). Overcoming the early-stage conundrum of digital platform ecosystem emergence: A problem-solving perspective. *Journal of Management Studies, 58*(7), 1899–1932. https://doi.org/10.1111/joms.12748
Nambisan, S., & Sawhney, M. (2011). Orchestration processes in network-centric innovation: Evidence from the field. *Academy of Management Perspectives, 25*(3), 40–57. https://doi.org/10.5465/amp.25.3.zol40
Nambisan, S., Zahra, S. A., & Luo, Y. (2019). Global platforms and ecosystems: Implications for international business theories. *Journal of International Business Studies, 50*(9), 1464–1486. https://doi.org/10.1057/s41267-019-00262-4
Nocke, V., Peitz, M., & Stahl, K. (2007). Platform ownership. *Journal of the European Economic Association, 5*(6), 1130–1160. https://doi.org/10.1162/jeea.2007.5.6.1130
Ohashi, H. (2003). The role of network effects in the US VCR market, 1978–1986. *Journal of Economics & Management Strategy, 12*(4), 447–494. https://doi.org/10.1111/j.1430-9134.2003.00447.x
Ozalp, H., Cennamo, C., & Gawer, A. (2018). Disruption in platform-based ecosystems. *Journal of Management Studies, 55*(7), 1203–1241. https://doi.org/10.1111/joms.12351
Panico, C., & Cennamo, C. (2022). User preferences and strategic interactions in platform ecosystems. *Strategic Management Journal, 43*(3), 507–529. https://doi.org/10.1002/smj.3149
Parker, G. G., & van Alstyne, M. W. (2005). Two-sided network effects: A theory of information product design. *Management Science, 51*(10), 1494–1504. https://doi.org/10.1287/mnsc.1050.0400
Parker, G., van Alstyne, M., & Jiang, X. (2017). Platform ecosystems: How developers invert the firm. *MIS Quarterly, 41*(1), 255–266. https://doi.org/10.25300/misq/2017/41.1.13
Penttinen, E., Halme, M., Lyytinen, K., & Myllynen, N. (2018). What influences choice of business-to-business connectivity platforms? *International Journal of Electronic Commerce, 22*(4), 479–509. https://doi.org/10.1080/10864415.2018.1485083
Perren, R., & Kozinets, R. V. (2018). Lateral exchange markets: How social platforms operate in a networked economy. *Journal of Marketing, 82*(1), 20–36. https://doi.org/10.1509/jm.14.0250
Ricart, J. E., Snihur, Y., Carrasco-Farré, C., & Berrone, P. (2020). Grassroots resistance to digital platforms and relational business model design to overcome it: A conceptual framework. *Strategy Science, 5*(3), 271–291. https://doi.org/10.1287/stsc.2020.0104
Rietveld, J., & Schilling, M. A. (2021). Platform competition: A systematic and interdisciplinary review of the literature. *Journal of Management, 47*(6), 1528–1563. https://doi.org/10.1177/0149206320969791
Rietveld, J., Schilling, M. A., & Bellavitis, C. (2019). Platform strategy: Managing ecosystem value through selective promotion of complements. *Organization Science, 30*(6), 1232–1251. https://doi.org/10.1287/orsc.2019.1290
Rochet, J.-C., & Tirole, J. (2002). Cooperation among competitors: Some economics of payment card associations. *The RAND Journal of Economics, 33*(4), 549–570. https://doi.org/10.2307/3087474
Rochet, J.-C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association, 1*(4), 990–1029. https://doi.org/10.1162/154247603322493212
Rochet, J.-C., & Tirole, J. (2006). Two-sided markets: A progress report. *The RAND Journal of Economics, 37*(3), 645–667. https://doi.org/10.1111/j.1756-2171.2006.tb00036.x
Rysman, M. (2004). Competition between networks: A study of the market for yellow pages. *The Review of Economic Studies, 71*(2), 483–512. https://doi.org/10.1111/0034-6527.00512
Saadatmand, F., Lindgren, R., & Schultze, U. (2019). Configurations of platform organizations: Implications for complementor engagement. *Research Policy, 48*(8), 103770. https://doi.org/10.1016/j.respol.2019.03.015
Sandberg, J., Holmström, J., & Lyytinen, K. (2020). Digitization and phase transitions in platform organizing logics: Evidence from the process automation industry. *MIS Quarterly, 44*(1), 129–153. https://doi.org/10.25300/misq/2020/14520
Sarker, S., Sarker, S., Sahaym, A., & Bjørn-Andersen, N. (2012). Exploring value cocreation in relationships between an ERP vendor and its partners: A revelatory case study. *MIS Quarterly, 36*(1), 317–338. https://doi.org/10.2307/41410419
Schilke, O., Hu, S., & Helfat, C. E. (2018). Quo vadis, dynamic capabilities? A content-analytic review of the current state of knowledge and recommendations for future research. *Academy of Management Annals, 12*(1), 390–439. https://doi.org/10.5465/annals.2016.0014
Shapiro, C., & Varian, H. R. (1998). *Information rules: A strategic guide to the network economy*. Harvard Business School Press.
Shi, X., Li, F., & Chumnumpan, P. (2021). Platform development: Emerging insights from a nascent industry. *Journal of Management, 47*(8), 2037–2073. https://doi.org/10.1177/0149206320929428
Shipilov, A., & Gawer, A. (2020). Integrating research on interorganizational networks and ecosystems. *Academy of Management Annals, 14*(1), 92–121. https://doi.org/10.5465/annals.2018.0121
Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039
Song, P., Xue, L., Rai, A., & Zhang, C. (2018). The ecosystem of software platform: A study of asymmetric cross-side network effects and platform governance. *MIS Quarterly, 42*(1), 121–142. https://doi.org/10.25300/misq/2018/13737
Spagnoletti, P., Resca, A., & Lee, G. (2015). A design theory for digital platforms supporting online communities: A multiple case study. *Journal of Information Technology, 30*(4), 364–380. https://doi.org/10.1057/jit.2014.37
Stonig, J., & Müller-Stewens, G. (2019). Navigating the challenges of ecosystem emergence. *Die Unternehmung, 73*(4), 288–307. https://doi.org/10.5771/0042-059X-2019-4-288
Stonig, J., Schmid, T., & Müller-Stewens, G. (2022). From product system to ecosystem: How firms adapt to provide an integrated value proposition. *Strategic Management Journal, Advance Online Publication.* https://doi.org/10.1002/smj.3390
Stremersch, S., Tellis, G. J., Hans Franses, P., & Binken, J. L. G. (2007). Indirect network effects in new product growth. *Journal of Marketing, 71*(3), 52–74. https://doi.org/10.1509/jmkg.71.3.052
Sun, M., & Tse, E. (2009). The resource-based view of competitive advantage in two-sided markets. *Journal of Management Studies, 46*(1), 45–64. https://doi.org/10.1111/j.1467-6486.2008.00796.x
Svahn, F., Mathiassen, L., & Lindgren, R. (2017). Embracing digital innovation in incumbent firms: How Volvo cars managed competing concerns. *MIS Quarterly, 41*(1), 239–253. https://doi.org/10.25300/misq/2017/41.1.12
Tan, G., & Zhou, J. (2021). The effects of competition and entry in multi-sided markets. *The Review of Economic Studies, 88*(2), 1002–1030. https://doi.org/10.1093/restud/rdaa036

Tan, B., Pan, S., Lu, X., & Huang, L. (2015). The role of IS capabilities in the development of multi-sided platforms: The digital ecosystem strategy of Alibaba.com. *Journal of the Association for Information Systems, 16*(4), 248–280. https://doi.org/10.17705/1jais.00393

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319–1350. https://doi.org/10.1002/smj.640

Teece, D. J. (2018). Profiting from innovation in the digital economy: Enabling technologies, standards, and licensing models in the wireless world. *Research Policy, 47*(8), 1367–1387. https://doi.org/10.1016/j.respol.2017.01.015

Thomas, L. D. W., & Ritala, P. (2022). Ecosystem legitimacy emergence: A collective action view. *Journal of Management, 48*(3), 515–541. https://doi.org/10.1177/0149206320986617

Thomas, L. D. W., Autio, E., & Gann, D. M. (2014). Architectural leverage: Putting platforms in context. *Academy of Management Perspectives, 28*(2), 198–219. https://doi.org/10.5465/amp.2011.0105

Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Research commentary—Digital infrastructures: The missing IS research agenda. *Information Systems Research, 21*(4), 748–759. https://doi.org/10.1287/isre.1100.0318

Tiwana, A. (2008). Does technological modularity substitute for control? A study of alliance performance in software outsourcing. *Strategic Management Journal, 29*(7), 769–780. https://doi.org/10.1002/smj.673

Tiwana, A. (2014). *Platform ecosystems: Aligning architecture, governance, and strategy*. Morgan Kaufmann.

Tiwana, A. (2015). Evolutionary competition in platform ecosystems. *Information Systems Research, 26*(2), 266–281. https://doi.org/10.1287/isre.2015.0573

Tiwana, A. (2018). Platform synergy: Architectural origins and competitive consequences. *Information Systems Research, 29*(4), 829–848. https://doi.org/10.1287/isre.2017.0739

Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Research commentary—Platform evolution: Coevolution of platform architecture, governance, and environmental dynamics. *Information Systems Research, 21*(4), 675–687. https://doi.org/10.1287/isre.1100.0323

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management, 14*(3), 207–222. https://doi.org/10.1111/1467-8551.00375

Tschang, F. T. (2021). Platform-dependent entrepreneurs: Participants in an expanding universe of platforms? *Academy of Management Perspectives, 35*(4), 696–701. https://doi.org/10.5465/amp.2020.0140

Tsoukas, H. (2017). Don't simplify, complexify: From disjunctive to conjunctive theorizing in organization and management studies. *Journal of Management Studies, 54*(2), 132–153. https://doi.org/10.1111/joms.12219

Tudón, J. (2022). Prioritization vs. congestion on platforms: Evidence from Amazon's twitch.tv. *The RAND Journal of Economics, 53*(2), 328–355. https://doi.org/10.1111/1756-2171.12409

Valverde, S. C., Chakravorti, S., & Fernández, F. R. (2016). The role of interchange fees in two-sided markets: An empirical investigation on payment cards. *The Review of Economics and Statistics, 98*(2), 367–381. https://doi.org/10.1162/REST_a_00502

van de Ven, A. H., & Poole, M. S. (1995). Explaining development and change in organizations. *Academy of Management Review, 20*(3), 510–540. https://doi.org/10.5465/amr.1995.9508080329

van de Ven, A. H., & Poole, M. S. (2005). Alternative approaches for studying organizational change. *Organization Studies, 26*(9), 1377–1404. https://doi.org/10.1177/0170840605056907

Venkatraman, N., & Lee, C.-H. (2004). Preferential linkage and network evolution: A conceptual model and empirical test in the U.S. video game sector. *Academy of Management Journal, 47*(6), 876–892. https://doi.org/10.5465/20159628

Vuori, T. O., & Huy, Q. N. (2016). Distributed attention and shared emotions in the innovation process: How Nokia lost the smartphone battle. *Administrative Science Quarterly, 61*(1), 9–51. https://doi.org/10.1177/0001839215606951

Wang, Z., & Wright, J. (2017). Ad valorem platform fees, indirect taxes, and efficient price discrimination. *The RAND Journal of Economics, 48*(2), 467–484. https://doi.org/10.1111/1756-2171.12183

Wang, C., & Wright, J. (2020). Search platforms: Showrooming and price parity clauses. *The RAND Journal of Economics, 51*(1), 32–58. https://doi.org/10.1111/1756-2171.12305

Wareham, J., Fox, P. B., & Cano Giner, J. L. (2014). Technology ecosystem governance. *Organization Science, 25*(4), 1195–1215. https://doi.org/10.1287/orsc.2014.0895

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly,* 26(2), xiii–xxiii. https://www.jstor.org/stable/4132319

Weyl, E. G. (2010). A price theory of multi-sided platforms. *American Economic Review, 100*(4), 1642–1672. https://doi.org/10.1257/aer.100.4.1642

Wright, J. (2004). One-sided logic in two-sided markets. *Review of Network Economics, 3*(1), 45–64. https://doi.org/10.2202/1446-9022.1042

Wright, J. (2012). Why payment card fees are biased against retailers. *The RAND Journal of Economics, 43*(4), 761–780. https://doi.org/10.1111/1756-2171.12007

Yin, P.-L., Davis, J. P., & Muzyrya, Y. (2014). Entrepreneurial innovation: Killer apps in the iPhone ecosystem. *American Economic Review, 104*(5), 255–259. https://doi.org/10.1257/aer.104.5.255

Yoo, Y., Boland, R. J., Lyytinen, K., & Majchrzak, A. (2012). Organizing for innovation in the digitized world. *Organization Science, 23*(5), 1398–1408. https://doi.org/10.1287/orsc.1120.0771

Young Kang, H., & Suarez, F. F. (2022). Platform owner entry into complementor spaces under different governance modes. *Journal of Management,* Advance online publication, 1–35. https://doi.org/10.1177/01492063221094759

Zapadka, P., Hanelt, A., & Firk, S. (2022). Digital at the edge: Antecedents and performance effects of boundary resource deployment. *The Journal of Strategic Information Systems, 31*(1), 101708. https://doi.org/10.1016/j.jsis.2022.101708

Zeng, J., & Glaister, K. W. (2016). Competitive dynamics between multinational enterprises and local internet platform companies in the virtual market in China. *British Journal of Management, 27*(3), 479–496. https://doi.org/10.1111/1467-8551.12136

Zhang, Y., Li, J., & Tong, T. W. (2022). Platform governance matters: How platform gatekeeping affects knowledge sharing among complementors. *Strategic Management Journal, 43*(3), 599–626. https://doi.org/10.1002/smj.3191

Zhu, F., & Liu, Q. (2018). Competing with complementors: An empirical look at Amazon.com. *Strategic Management Journal, 39*(10), 2618–2642. https://doi.org/10.1002/smj.2932

Zhu, F., Li, X., Valavi, E., & Iansiti, M. (2021). Network interconnectivity and entry into platform markets. *Information Systems Research, 32*(3), 1009–1024. https://doi.org/10.1287/isre.2021.1010