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Overcoming the Early-stage Conundrum of Digital Platform Ecosystem Emergence: A Problem-Solving Perspective

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ABSTRACT Platform sponsors and complementors co-create value in digital platform ecosystems. But how does a digital platform ecosystem emerge in the incipient stage, especially in a situation where value co-creation involves attracting complementors to platform sponsors who are unknown to one another? We posit that a platform sponsor's choice of scope signals value co-creation opportunities and thereby attracts complementors and consumers. We draw upon the problem-solving perspective, rooted in the knowledge-based view of the firm, to shift the emphasis away from the actor ('who') to the problem at hand ('what') and demonstrate how incipient platform sponsors can align their scope with the problem to stimulate ecosystem emergence. Using fuzzy-set qualitative comparative analysis on a dataset of crowdfunding campaigns, we identify multiple pathways and associated propositions for successful emergence of digital platform ecosystems, notably for innovation, open-source, and information ecosystems. The framework we conceptualize highlights novel considerations to overcome the early-stage challenge of attracting participation to an ecosystem that is yet to emerge.

Keywords: digital platforms, ecosystem emergence, fsQCA, knowledge-based view, platform scope, problem-solving

INTRODUCTION

Digital platform-based ecosystems (hereafter referred to as platform ecosystems) have proliferated across several industries and geographies. As an organizational form, they have shifted the locus of value creation from the inner core of the focal firm to co-creation with external autonomous actors called complementors (Adner and Kapoor, 2010; Kapoor, 2018). Much of the research on platform ecosystems has shown keen interest in larger and well-established platforms like Apple and Amazon, with scholars

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seeking to understand the sources of their value creation and growth (McIntyre et al., 2020). In contrast, the long tail of platforms that struggle in the incipient stage remains largely ignored (Dattée et al., 2018). Moreover, although a shared understanding and agreement of the scope of activities of the respective actors – in this case platform sponsors and complementors – is fundamental to co-creation of value (Gulati et al., 2012), there has been a limited understanding regarding the choice of the scope of the platform sponsor vis-à-vis complementors (McIntyre et al., 2020). Our paper focuses on the long tail of platforms in the incipient stage, with a specific focus on the role of the platform sponsor's scope on platform ecosystem emergence.

The successful emergence of a platform ecosystem implies that the platform survived the incipient stage by attracting voluntary participation of complementors and consumers (Ceccagnoli et al., 2012; McIntyre and Srinivasan, 2017). Yet firms in the incipient stage are faced with a major conundrum. In the case of more established ecosystems, factors such as superior technology infrastructure (Constantinides et al., 2018; Tiwana, 2013), first mover advantage (Gawer and Cusumano, 2014), incentives and subsidies (Caillaud and Jullien, 2003; McIntyre and Subramaniam, 2009) and creation of social forums (Fang et al., 2021), among others, have been shown to attract the contributions of potential participants to their ecosystems. However, incipient platform firms typically do not have recourse to these avenues, nor do they possess the resources to create them in order to make the platform attractive to potential participants.

We propose that a platform sponsor's scope choices offer a way out of this dilemma. Platform sponsors have to make key decisions about their scope, at the outset as well as continually, in order to signal to autonomous complementors potential opportunities for value creation and capture (Cusumano and Gawer, 2002; Kapoor and Lee, 2013). The platform sponsor's choice of scope is particularly critical at the initial stage to attract participation and ensure commitment from the autonomous actors to the '*de novo* ecosystem' (Autio and Thomas, 2020; Dattée et al., 2018, p. 467; Hannah and Eisenhardt, 2018). Prior research has suggested that platform sponsors should choose their scope considering factors such as their dependence on complementors (Cusumano and Gawer, 2002), modular design attributes (Tiwana et al., 2010) and the value proposition of the ecosystem (Adner, 2017). Although a useful guideline, these studies do not sufficiently emphasize that complementors are often unknown ex-ante (Gawer, 2011), a scenario particularly relevant for digital platforms. It is thus not clear how platform sponsors should define their scope at the initial stage to attract potential participants.

In this paper we ask: *How does a digital platform sponsor's choice of scope facilitate the emergence of a platform ecosystem?* To answer this research question, we base our arguments on one strain of the knowledge-based theory of the firm, namely the problem-solving perspective (PSP), which argues that 'problem-solving effectiveness is key to superior organizational performance' (Jeppesen and Lakhani, 2010, p. 1016; Nickerson and Zenger, 2004). The PSP posits that the efficiency of the solution search, at its core, is dependent on the alignment between the problem dimensions and the governance mode of the search process (Nickerson and Zenger, 2004; Nickerson et al., 2012; Macher, 2006). From this line of argument, the platform sponsor as the focal economic actor seeks to efficiently solve

a problem whose solution, in the form of complements, creates value for the consumers and is a manifestation of the commitment of complementors to the ecosystem. Our major premise is that a digital platform ecosystem emerges when the platform sponsor stimulates an efficient search process through a choice of scope that accords with the problem they seek to solve. We theorize that, on one hand, problem dimensions shape the type of search process required to find solutions and, on the other hand, the platform sponsor scope shapes the extent to which the sponsor can govern the search process. Platform sponsor scope is comprised of (a) the set of activities that the sponsor chooses to perform internally and (b) the extent to which the sponsor holds decision rights over the complementors' solutions. As the search process moves from being semi-directed by the sponsor to being undirected, a corresponding reduction in the platform sponsor scope is required for the search to be efficient and lead to the emergence of an ecosystem (see Figure 2 and theory below).

Our investigation identifies distinct pathways to survive the incipient stage and enable ecosystem emergence. We adopt abductive reasoning (Mantere and Ketokivi, 2013) and fuzzy set qualitative comparative analysis (fsQCA) to arrive at various configurations of problem dimensions and platform sponsor scope that lead to ecosystem emergence. Our analysis utilizes a dataset of campaigns posted on a crowdfunding website to raise funds to launch digital platforms. Using the fsQCA results and case knowledge, we identify configurations of problem dimensions and platform sponsor scope for complementary innovation ecosystems, open-source ecosystems, and information ecosystems. Complementary innovation ecosystems align a semi-directed search process with a broad sponsor scope. Open-source ecosystems employ a new type of search that we term as community-directed search with a moderate sponsor scope. Finally, information ecosystems utilize an orchestrated-undirected search with a narrow sponsor scope.

Our paper makes a number of contributions: First, we shed light on the much-neglected incipient stage and demonstrate both theoretically and empirically how platform sponsors can facilitate the emergence of digital platform ecosystems. The framework we provide helps visualize and better understand the alignment between the problem and scope, a novel set of considerations to tackle the early-stage challenge of attracting participation to an unknown platform. Second, in extending the problem-solving perspective to the platform literature and accordingly shifting the analytical lens from the actors to the problem, we overcome the difficulty in examining emergence of ex-ante unknown complementors in the ecosystem (Gawer and Cusumano, 2014). In doing so, we also demonstrate how micro-level aspects such as problem and scope have broader ecosystem-level implications, a finding that can be beneficial to study broader digital strategy issues. Finally, we bring a configurational approach with abductive reasoning to the study of digital platforms by developing several propositions for the successful emergence of incipient ecosystems. The configuration of problem dimensions and platform sponsor scope highlights equifinality in reaching the outcome and identifies multiple pathways for successful ecosystem emergence. Here, we empirically identify a distinct solution search process, i.e., community-directed search, that complements the search processes highlighted in the PSP literature.

EMERGENCE OF DIGITAL PLATFORM ECOSYSTEMS

The fundamental tenet of value creation in platform ecosystems is the platform sponsor co-creating value with autonomous complementors (Ceccagnoli et al., 2012; Kapoor, 2018). With the participation of complementors and availability of valuable complements thereof, consumers are attracted to consume the ecosystem offerings. Such a positive loop of attraction of actors across the different sides of the platform drives overall participation and leads to the emergence of an ecosystem of complementors and consumers around the platform (Gawer, 2014; McIntyre and Srinivasan, 2017). In the broader ecosystems literature, it has been argued that platform sponsors can attract participation by identifying a compelling blueprint (Iansiti and Levien, 2004) or value proposition (Adner, 2017), balancing cooperation and competition tensions (Hannah and Eisenhardt, 2018) and producing a few complements in-house (Schilling, 2002). However, these strategies may be insufficient when the platforms are built on digital technologies that can support a variety of visions and complements (Dattée et al., 2018).

With digital technologies typically characterized by a modular platform architecture, which allows a diverse set of actors to develop their own products over the platform with little or no coordination (Baldwin and Clark, 2006; Cennamo and Santaló, 2019; Tiwana, 2013; Zittrain, 2005), digital platforms can be best characterized as a context of *distributed assets*. The modular nature of such technologies makes it impossible for a single firm to conceptualize, modify or extend the technologies in-house to produce all variants of value-enhancing complements. Importantly, in this context, not only are complementors unknown ex ante but also their complements are unknown ex ante to the platform sponsor, a condition of unknown unknowns (Tajedin et al., 2019). The digital context has close similarities to that characterizing the knowledge setting where 'knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess' (Hayek, 1945, p. 519). Whereas the economic problem in the knowledge context is to find the best way to utilize knowledge 'not given to anyone in its totality' (Hayek, 1945, p. 520), that in digital platforms is to find the best way to utilize assets not owned by any single firm in totality, but rather affiliated with a platform (Hagiu and Wright, 2015). Thus, digital platform ecosystems readily lend themselves to the lens of knowledge-based theories to analyze value creation.

One recent and increasingly prominent strain of the knowledge-based theory of the firm argues that a focal firm's effectiveness in problem-solving is vital for superior organizational performance (Jeppesen and Lakhani, 2010; Nickerson and Zenger, 2004; Nickerson et al., 2007). The central theme of the problem-solving perspective (PSP) is that the focal economic actor seeks to solve a problem but is unable to do so efficiently by itself due to limitations of resources, time, and cognition. Consequently, the actor engages in solution search in close proximity or at a distance, the choice of which is based on the problem and solution landscape (Afuah and Tucci, 2012; Macher, 2006; Nickerson and Zenger, 2004). Since the search for solutions can be afflicted by hazards, such as actors misguiding the search for their own benefit or misappropriating the value created through solutions, the focal actor chooses a governance mode that mitigates hazards to facilitate efficient search and value creation.

In the digital context, the problem to be solved constitutes finding valuable complements that enhance the overall value of the ecosystem. By analyzing the problem as the unit of analysis from the point of view of a focal actor (Nickerson and Zenger, 2004), the problem-solving perspective can help overcome a major hindrance in studying emergence of ecosystems – the difficulty in assessing and following ex-ante unknown complementors and users who are vital for ecosystem emergence (Gawer and Cusumano, 2014). We can assess ecosystem emergence from the platform sponsor's perspective by studying the efficacy of problem-solving, which occurs through the contributions of complementors and thereby participation of consumers. Thus, analyzing how valuable solutions to a problem, in the form of complements, may be found leads to assessing the emergence of the ecosystem.

Figure 1 summarizes our theoretical framework. We develop our arguments to explain the emergence of digital platform ecosystems based on the problem-solving perspective. As we detail in the following sections, the platform sponsor's choice of scope should be aligned with the problem for an efficient search for valuable complements. We identify configurational alignments among the different dimensions of problem and scope that manifest as pathways to successful ecosystem emergence.

Problem Solving in Digital Platform Ecosystems

The problem dimensions shape the type of search process required to find solutions (Macher, 2006). The problem-solving perspective matches search process with governance forms that support efficient solution search (see Figure 2). When the problem can be solved independently by diverse actors without direction from the focal actor, it

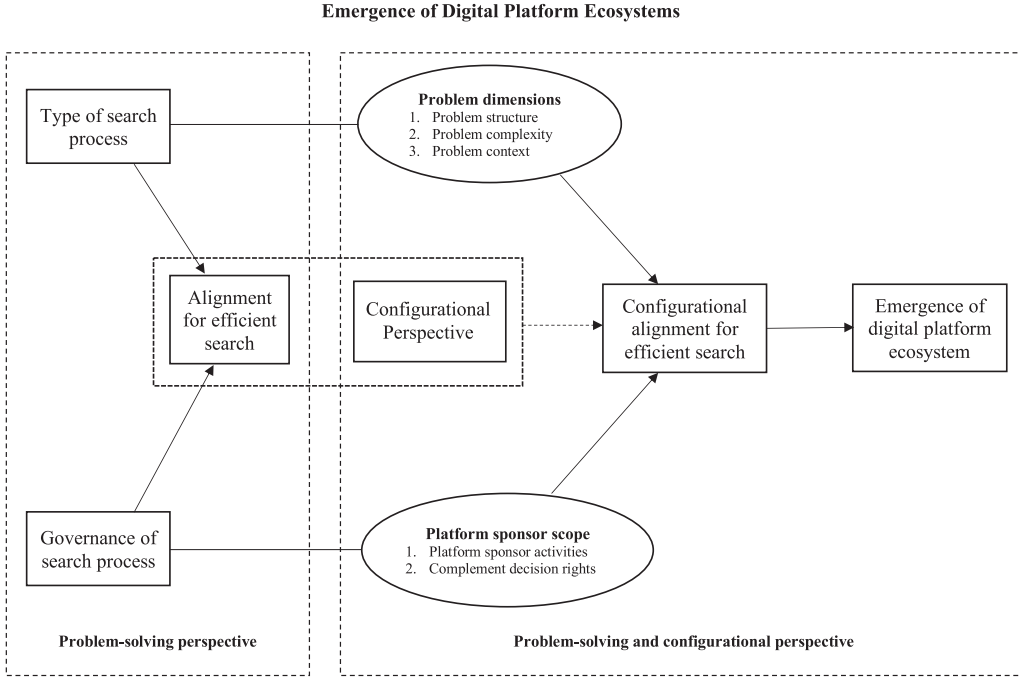

Figure 1. Emergence of digital platform ecosystems

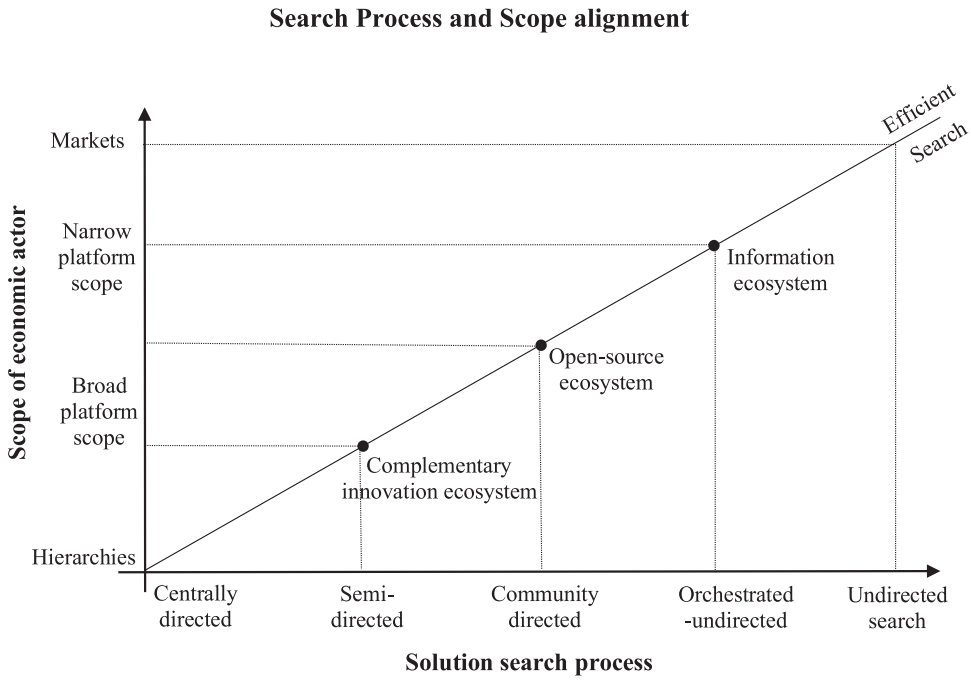

Figure 2. Search process and scope alignment

is more efficient to use an undirected search for a greater reach (Nickerson and Zenger, 2004). Undirected search is a process where independent actors 'sequentially alter one solution design choice at a time, observe whether the solution value improves or declines in response and then update accordingly' (Felin and Zenger, 2014, p. 916). Such a trial-and-error-driven undirected search that is decentralized is best supported using a market form of governance (Nickerson and Zenger, 2004). Markets use a discovery process to access multiple agents and mobilize their dispersed knowledge (Hayek, 1945) and are best suited to discover problem-solution pairs (von Hippel and von Krogh, 2015) or solve uncertainty problems where the focal actor does not know what to look for beforehand.

In contrast, when the problem is complex and solution design choices have interdependencies that are poorly understood, direct feedback from independent trial and error is less useful. Such a problem requires a central actor or group of actors to take a more holistic approach to 'assemble relevant knowledge, then recombine it, and then compose a theory' that can drive the search (Felin and Zenger, 2014, p. 917). Here, the solution may need to be found in proximity to the cognitive landscape of the focal actor to allow the use of their heuristics or theories (Nickerson and Zenger, 2004). A hierarchical governance form can best support such a centrally directed search process. Such a search is suitable to solve uncertainty problems that have a known starting point in the form of theories, consensus, or heuristics.

In sum, the extreme positions of a centrally directed search and an undirected search are governed efficiently using the hierarchy and market forms of governance respectively.

Next, we theorize about the search processes between the two extremes, building on problem-solving in platform ecosystems.

Digital platform ecosystems are argued to offer organizational efficiency relative to other forms with their ability to solve uncertainty problems while using a discovery procedure that is orchestrated for the benefit of the focal firm. Here, the 'distributed knowledge of a mass of outside participants is leveraged' and augmented with the firm's knowledge (Tajedin et al., 2019, p. 339). When the focal actor knows the problem, the ecosystem facilitates finding a solution by broadcasting the problem to a diverse set of actors and enabling efficient access to cognitively distant knowledge sets (Afuah and Tucci, 2012; Jeppesen and Lakhani, 2010). Since the starting point of 'what to look for' is known, the search process is termed to be *semi-directed* (Figure 2), with the market elements employed only on the demand side of economic value creation. Unlike the centrally directed search process where the relevant knowledge is assembled by the focal actor, the semi-directed search process involves 'broadcasting the problem in hopes that those with valuable information or valuable solutions will reveal themselves' (Felin and Zenger, 2014, p. 917; Jeppesen and Lakhani, 2010). The semi-directed search also differs from the undirected search as the discovery procedure is constrained by the known problem definition.

In contrast, when the focal actor does not know the problem to be solved, then market elements are employed on both the supply and demand sides of economic value creation. We term such a search process as *orchestrated yet undirected* (hereafter referred to as *orchestrated-undirected*) search (Figure 2). The search process no longer relies on the focal firm's knowledge to define the problem or assemble relevant knowledge. Consequently, the search process is undirected where the 'supply side crowd focuses on a variety of problems specified by the demand side crowd' (Tajedin et al., 2019, p. 330). In this scenario, the platform sponsor's role is to facilitate the market matching mechanisms through the platform while orchestrating the search indirectly for their own benefit.

Problem and Scope Alignment

We argued above that digital platform ecosystems employ semi-directed and orchestrated-undirected search processes to find valuable solutions (Tajedin et al., 2019). The problem-solving perspective suggests that the search process to solve a problem is efficient when it is governed by the right governance mode (Nickerson and Zenger, 2004). In digital platform ecosystems, for an efficient search the platform sponsor as the focal actor should have the required latitude in the governance of the search process. As we detail below, the platform sponsor scope choices shape the extent to which the sponsor has latitude to govern the search process within ecosystems. The semi-directed and orchestrated-undirected search processes of the ecosystem are efficiently governed when the platform sponsor has a broad and narrow scope respectively (Figure 2). Specifically, we contend that, when the problem requires the platform sponsor to direct the search, their scope should be broad enough to have latitude over a greater range of activities and assets. The semi-directed search process requires that the platform sponsor retain latitude in governance to define the problem, broadcast the problem for a solution search, and select the suitable solution. Thus, the platform sponsor should retain a broad scope to define the problem as well as absorb the solution complements into existing offerings.

In contrast, when the search process tends to require less direction from the platform sponsor due to the nature of the problem, their scope should be correspondingly narrower for the search to be efficient. The limited role of the platform sponsor in facilitating the market matching mechanisms in an undirected search implies that they choose to retain a narrow scope of value creation activities and limited latitude in governing the search process. This arrangement of limited governance may be more conducive to serendipitous discovery of problem-solution pairs (von Hippel and von Krogh, 2015). However, the platform sponsor as the designer of the market has the ability to orchestrate (Boudreau and Hagiu, 2009; Choudary et al., 2016) the search process indirectly for their own benefit (Helfat and Raubitschek, 2018).

In sum, platform ecosystems offer a middle ground – i.e., between undirected and centrally directed – in efficient search processes, such that a known problem can be solved using semi-directed search whereas an unknown problem may be solved using an undirected but orchestrated search process. The search is efficient when the problem aligns with the platform sponsor scope, such an alignment depicting attractive opportunities for value creation and capture to the potential complementors and consumers. An efficient search would find valuable solutions in the form of complements, which is a manifestation of the attraction as well as commitment of complementors and consumers to the ecosystem. Thus, our major premise is that *a digital platform ecosystem emerges when there is an alignment between the problem and platform sponsor scope*.

In the following sections we explicate the elements constituting the problem and platform sponsor scope. Then, using abductive reasoning we identify practically relevant configurations of these elements associated with successful ecosystem emergence. We then specify our minor premises that bring more granularity to our argument of alignment between problem and scope.

DIGITAL PLATFORM SPONSOR SCOPE

The scope of the firm is a major strategic decision for firms and its impact on firm performance has long been considered a critical issue in strategic management research, with much scholarship having been dedicated to identify factors that the focal firm has to consider in making this key decision (Ahuja and Novelli, 2017). The choice of firm scope shapes firms' strategies, likelihood of survival, performance outcomes and its competitive environment (Zenger et al., 2011).

Broadly speaking, there are two aspects defining firm scope: external scope, which refers to the choice of products and markets in which the firm chooses to compete, and internal scope, which refers more specifically to which value creation activities the firm chooses to retain within its boundaries. For our purposes we are more concerned with internal scope. Retaining activities within their boundaries facilitates firms to maintain control over decision-making regarding those criteria that, in the ecosystem context, enables them to facilitate coordination with other actors (Boudreau, 2010; Tiwana, 2013; Tiwana et al., 2010). However, such hierarchical control is not the only avenue available to firms. An alternate avenue for control over decision-making is through contracts with complementors, which assigns them decision rights over select aspects

of complements and complementors' actions, such as timing of release and integration of the complement with other offerings on the focal platform. Our treatment of the term scope incorporates both aspects of broader control and more selective decision-rights.

Early work referred to platform scope as the platform sponsor's choice of which complements to make internally and which to leave to autonomous complementors (Cusumano and Gawer, 2002). More recent studies have adopted broader definitions of platform scope as the role played by the platform in the digital markets they enable (Cennamo, 2019) and the 'vision that defines the ecosystem value proposition' (Dattée et al., 2018, p. 467). We refer to *platform sponsor scope* as constituting the activities that the sponsor chooses to perform internally and the extent of decision rights over complements. Our conceptualization of platform sponsor scope as the activities a firm chooses to engage in encompasses prior definitions because at a more granular level activities are what ultimately underpin the delivery of the value proposition. At the same time, by considering decision rights of complements we address the firm scope issue from the perspective of control (Boudreau, 2010; Gawer, 2014; Gawer and Henderson, 2007), which is vital for a collaborative arrangement.

Platform Sponsor Activities

Consumers derive value from both platform offerings as well as complements. Consequently, value creation activities are performed by both the platform sponsor and the complementors (Adner and Kapoor, 2010). The distribution of value creation activities between the platform sponsor and complementors manifests in the ecosystem structure (Adner, 2017), wherein actors undertake activities to materialize the value proposition by assuming distinct positions within the ecosystem. Since value propositions are often not fully known ex ante (Dattée et al., 2018), platform sponsors choose at the outset which activities to perform internally depending on their resource configurations. Such a choice of activities to perform internally is in effect the choice of the platform sponsor scope. As Adner (2017) rightly highlights, the scope decision puts forth a 'vision of structure and roles [to which] others defer' (p. 48). Thus, the platform sponsor's agency in choosing its scope to materialize the value proposition or solve the focal problem is a first step for the rest of the ecosystem structure to emerge.

The platform sponsor's choice of activities to perform internally is fundamental at the initial stage in order to attract complementors and consumers and ensure their commitment to the *de novo* ecosystem (Dattée et al., 2018; Hannah and Eisenhardt, 2018). The platform sponsor's activities signal its vision for the future ecosystem and the digital market in terms of how value may be created and the kind of complementors that can participate on the platform. When complementors and consumers perceive these signals as beneficial, they choose to participate on the platform that then ultimately leads to the emergence of an ecosystem. Furthermore, the platform sponsor's activity choices define the kind of interactions that are available to prospective complementors on the platform and thereby shapes the type of market the platform enables (Cennamo, 2019; Hagiu and Wright, 2019; Jerath and Zhang, 2010).

Complement Decision Rights

In addition to defining their scope in terms of value creation activities, platform sponsors can expand their scope through assuming decision rights over the complements. When they have decision rights over the complements, the platform sponsors can better control the quality, variety, and timing of release of the complements and thereby improve their competitive position (Cennamo and Santalo, 2013; Wareham et al., 2014). We contend that the platform sponsors make a strategic decision about the complement decision rights similar to the choice of value creation activities to perform internally. The platform sponsor's authority over the complement decision rights signals the extent of control complementors would have on their contributions to the ecosystem and the opportunities for value capture. The potential for value capture is particularly important in the initial stages to attract participation of complementors.

Platform sponsor scope expansion through complement decision rights may occur through arrangements such as quality control and review procedures (Wareham et al., 2014) as well as when the complementors cede complete control of the complements after producing them, such as in crowdsourcing and innovation contests (Felin and Zenger, 2014). In ecosystems aimed at producing open-source hardware and software, the decision rights of the platform offerings and the complements resides within the community of ecosystem participants (Jeppesen and Frederiksen, 2006). In ecosystems where the sponsor is more like a market intermediary, the decision rights of the complements remains with the autonomous complementors (Hagiu and Yoffie, 2009; Thomas et al., 2014). In sum, there exists heterogeneity in who holds the complement decision rights within the ecosystem, which contributes to alternative platform sponsor scope choices.

Overall, the platform sponsor scope choice shapes the sponsor's latitude to govern the search process and, more broadly, the ecosystem. Ecosystems are governed to foster complementary innovation but 'appropriately bound [the] participant behavior' to result in coherent value propositions (Wareham et al., 2014, p. 1195). Platform sponsors govern the ecosystem using strategies such as controlling the core platform modules opened to complementors (Boudreau, 2010; Parker and Van Alstyne, 2017), restricting the variety of complements (Wareham et al., 2014) and selectively incentivizing specific behaviour and products over others (Rietveld et al., 2020). Such strategies can be implemented when the platform sponsors have access and control over the corresponding parts of the value creation process. However, the platform sponsor's scope choice limits their access and control, and therefore their latitude to govern, to the value creation activities they choose to perform internally or to the complements they control.

PROBLEM DIMENSIONS

So far, we have argued that efficient search processes in ecosystems are those where the scope of the platform sponsor is in accordance with the search process. Facilitating an efficient search process is particularly important in the early stages of the ecosystem as the platform sponsor as the entrepreneur tries to discover valuable entrepreneurial opportunities in problem-solution pairs or at least increase the likelihood of discovering such opportunities (Hsieh et al., 2007). In this regard, prior research has established

Problem dimensions, Search Processes, and Platform Sponsor Scope Alignment

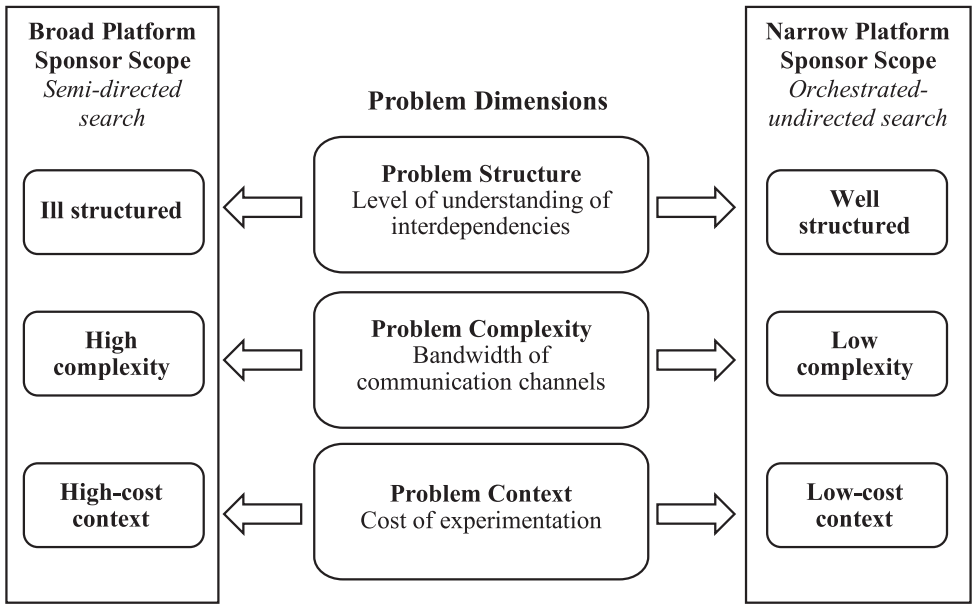

Figure 3. Problem dimensions, search processes, and platform sponsor scope alignment

that search processes are shaped by problem dimensions such as structure, context, and complexity (Felin and Zenger, 2014; Macher, 2006; Nickerson and Zenger, 2004). Thus, we now turn to examine how the different problem dimensions shape search processes (summarized in Figure 3) in platform ecosystems.

Problem Structure

The PSP posits that the solution to a problem is a process of searching for relevant knowledge sets within a solution landscape (Jonassen, 2004; Macher and Boerner, 2012). Problem structure refers to the level of understanding of the interdependencies among knowledge sets and the availability of formalized processes to reach the solution (Macher, 2006). Problems can vary along a continuum from ill-structured to well-structured, well-structured problems being 'those with well-defined initial states and known elements, explicit approaches for solving, and accepted end states [whereas] ill-structured problems have poorly defined initial states and indefinite problem-solving approaches' (Macher, 2006, p. 828). The underlying principle here is that, when knowledge set interdependencies are well understood, then formalized problem-solving processes exist that allows the search process to proceed undirected using independent trial and error-driven feedback mechanisms. In contrast, when the knowledge set interdependencies are not fully

understood, a centrally directed search process driven by the central actor's heuristics and theories to fulfill the lack of formalized problem-solving processes.

Extending the above logic to digital platform ecosystems it follows that the problem is well-structured when formalized problem-solving processes exist within the ecosystem and the complementors and sponsor recognize initial and accepted end states. Here, the actors operate independently within the formal processes, a setup that is conducive for an undirected search involving second-order uncertainty since 'all relevant knowledge sets are included and the path to high value solutions is clear' (Macher, 2006, p. 829). The platform ecosystem as a firm-designed market (Tajedin et al., 2019) then enables matching and finding problem-solution pairs among the available knowledge sets. Marketplaces such as eBay are examples of such ecosystems where the platform matches buyers and sellers of pre-defined products and uses formalized processes to complete the transactions. Additionally, the platform sponsor orchestrates the market to ensure enough participation on all sides as well as efficient and reliable transactions among the participants. Thus, well-structured problems are efficiently solved using an orchestrated-undirected search where the platform sponsor retains a narrow scope (Figure 3) to facilitate interaction between the supply and demand sides of the platform.

In contrast, when problems are ill-structured in platform ecosystems, actors may have poorly defined initial states and indefinite problem-solving processes. The platform sponsor as the central actor is required to guide the solution search by providing heuristics about the 'probable consequences of search decisions' (Macher, 2006, p. 829). The search guidance may involve the platform sponsor selecting or specifying the problems that are likely to be more valuable. The platform sponsor may also need to provide guidance on the accepted end state of the solution by defining conditions of valuable solutions and their absorption into the ecosystem (Tajedin et al., 2019). In sum, the platform sponsor plays a larger role of identifying the problem as well as absorbing the solution. Hence, ill-structured problems can be solved efficiently using a semi-directed search process where the platform sponsor retains a broader scope (Figure 3). Innovation platforms of video games are examples of such ecosystems where the console manufacturers control and orchestrate the game developers using technological bounds and procedural constraints (Cennamo, 2018; Ozalp and Kretschmer, 2019).

Problem Complexity

Solving a complex problem involves 'highly interdependent elements, choices, and knowledge sets that must be creatively recombined to compose valuable solutions' (Felin and Zenger, 2014, p. 916). Problem complexity is related to problem structure yet distinct from it. Whereas problem structure relates to the level of understanding of the interdependencies among knowledge sets, problem complexity relates to the magnitude of interdependencies between knowledge sets (Macher, 2006; Macher and Boerner, 2012). Consequently, as complexity increases, knowledge transfer and interaction between the actors holding dispersed knowledge sets becomes more costly. However, it is possible to economize on knowledge transfer costs by choosing an appropriate communication channel. Communication channel bandwidth refers to the 'degree of intensity of communication among individuals' and can vary between a more intense high bandwidth

channel and less intense low bandwidth channel (Heiman and Nickerson, 2004, p. 404; Hsieh et al., 2007). Since a complex problem involves higher interdependencies, the central actor's 'cognitive evaluations of the probable consequences of particular [search] decisions' are required, which is enabled by greater communication bandwidth (Macher, 2006, p. 830). In contrast, a simple problem with limited interdependencies can rely on low bandwidth trial-and-error feedback to guide solution search, thereby making an undirected search more efficient.

Extending the above argument to the case of digital platform ecosystems, it follows that when the problem is complex there would be high levels of interdependencies between the platform and the complements as well as among complements. Thus, for a coherent solution to take shape, the interdependencies should be resolved through extensive knowledge sharing and communication. The platform sponsor is required to facilitate such knowledge sharing and high bandwidth communication channels in addition to cognitive evaluations of potential solutions. However, in an ecosystem the emphasis is to reach beyond local knowledge sets to diverse complementors. Hence, a semi-directed search where the platform sponsor balances the need to direct the search whilst using market mechanisms to alleviate knowledge constraints is most efficient to find valuable solutions. The need for cognitive inputs from the platform sponsor during the search process implies that the sponsor should retain a broad scope (Figure 3). For example, platform sponsors like Apple enable solving complex problems through the development of apps by providing guidance on their platform, evaluating apps for performance, and enabling wider reach to diverse developers through easy-to-use software development kits.

In contrast, simple problems entail a lower magnitude of interdependencies between the platform and complements as well as among complements. The actors within the ecosystem may not need extensive knowledge sharing in developing their offerings and thus require only low bandwidth communication channels. Consequently, the complements are often not only highly fungible within the ecosystem but also can be made available on competing platforms, a scenario termed multi-homing (Cennamo et al., 2018). In terms of problem-solving, the solution search in such a scenario needs little guidance from a central actor and can thus proceed undirected but orchestrated to achieve solutions that benefit the sponsor and ecosystem at large. The limited role of the platform sponsor allows them to retain a narrow scope (Figure 3). Marketplaces like eBay are examples of ecosystems where sellers seek to sell largely standardized products and often sell same products on multiple marketplaces simultaneously.

Problem Context

Recent work in the PSP literature has argued that the problem context shapes the cost of experimenting to find valuable solutions and has implications for the search process (Furr et al., 2016; Nickerson et al., 2007). A high cost to experiment implies that the search for solutions requires costly resources or longer periods of time, resulting in a more constrained problem-solving process. Whereas cost of experimentation is vital, especially in the early stages, problem context can also include other factors that constrain problem-solving, such as the regulatory environment, that in effect increases the costs. The focal firm's choice of the problem implicitly includes the context since that often cannot be

changed. Thus, similar to the other problem dimensions discussed above, the context should be considered in choosing the governance form for efficient solution search.

A high-cost problem context involves costly experimentation to find valuable solutions. In such a context, the actors would plausibly prefer to invest their resources judiciously in design choices that could yield potentially valuable solutions. When the problem context is resource intensive or more constraining, and thus costly, then outcomes of experimental search are viewed through a risk averse lens (Furr et al., 2016). However, identifying what constitutes a valuable solution requires knowledge from prior trials and a broader vision of competing solutions, or simply put heuristics and theories. In digital platform ecosystems, solving a problem in a high-cost context would deter complementors from investing in developing complements around the *de novo* platform. The platform sponsor's guidance on the design choices for potentially valuable complements are key to overcome such deterrence in experimentation. Thus, the platform sponsor would require a broad scope to provide such guidance to aid the search (Figure 3). At the same time, the platform sponsor should allow room for innovation from diverse actors. The balance between guiding the search and fostering innovation (Boudreau, 2010, 2012) is attained using a semi-directed search process in platform ecosystems (Tajedin et al., 2019).

In contrast, a low-cost problem context is less expensive to experiment and find valuable solutions. Here, the problem solvers can perform independent trial-and-error based search and rely on feedback from their own trials to proceed with the search process, a scenario of orchestrated-undirected search. In digital platform ecosystems, a low-cost problem context could attract diverse set of complementors to experiment since the downsides are not significant. Moreover, problems with second-order uncertainty may be more conducive for such a search since platform sponsor's guidance is not required to identify valuable problem-solution pairs. Hence, the platform sponsor may choose to retain a narrow scope (Figure 3).

In sum, each of the problem dimensions shapes the extent to which the search for solutions requires guidance and direction of the platform sponsor and, consequently, the choice of the search process. However, the problem dimensions and the corresponding search process are rarely dichotomous and, as depicted in Figure 2, we expect that the search process varies over a continuum with centrally directed and undirected as the two ends.

ANALYTICAL APPROACH

To reiterate, each of the problem dimensions impacts some aspect of the solution search process. However, and importantly, the efficiency of the solution search depends not just on the focal problem dimension but also on the other dimensions that co-occur. Even though a problem has various distinct dimensions, such as structure, complexity, and context, these are interconnected and occur together as they describe different facets of the problem. Whereas each problem dimension may require a particular type of search process to find valuable solutions efficiently, it is plausible that the problem dimensions may require conflicting search processes. For example, consider a problem with high complexity in a low-cost context. Whereas high complexity would suggest a

semi-directed search to be efficient, a low-cost context allows for independent experimentation and therefore an undirected search. In such scenarios, it is not entirely clear which dimensions become important in determining the search process. Moreover, it is futile to determine the relative importance of problem dimensions since they co-occur and may not be effectively altered. Hence, it is necessary to consider the problem dimensions holistically in determining the efficient search process for the problem.

Furthermore, it is essential to consider both the elements of platform sponsor scope – platform sponsor activities and complement decision rights – in determining the most suitable governance form for an efficient search. The two elements co-occur in the context of platform ecosystems yet are distinct and shape the governance of the search process in different ways. The platform sponsor's choice of activities shapes the extent to which the sponsor can choose and define the problem, facilitate knowledge sharing and communication, as well as select and absorb solutions. The decision rights on complements defines who determines the value of solutions and how those solutions would be absorbed into the value propositions.

As we detail in the following sections, to address the above issues we employ a configurational perspective that relies on abductive reasoning as the mode of inquiry. The configurational perspective enables us to analyse the problem dimensions and platform sponsor scope elements more holistically, the alignment between the two for successful ecosystem emergence being our major premise. The abductive reasoning mode helps identify minor premises encompassing practically relevant configurations of the different elements of problem and scope, a vital step to bring more granularity to our major premise.

Configurational Perspective

The configurational approach constitutes a holistic mode of inquiry examining 'multidimensional constellations of conceptually distinct characteristics that commonly occur together' (Meyer et al., 1993, p. 1175). Fundamental to the configurational approach is the focus on identifying complex causal relationships, in the form of patterns or profiles of conditions related to an outcome of interest, rather than individual variables to identify the combined effects of causal conditions (Furnari et al., 2020; Meyer et al., 1993; Ragin, 2009). In our context, using a configurational approach helps identify patterns of problem dimensions and platform sponsor scope associated with successful emergence of ecosystems.

The configurational approach facilitates examining conjunctural causation of the various causal conditions, equifinality in outcomes, and asymmetry in causal relationships. Conjunctural causation is helpful to examine causal complexity where the outcomes 'result from the interdependence of multiple conditions' (Misangyi et al., 2017, p. 256) and thus the effect of a condition may vary based on the other co-occurring conditions, such as our scenario of co-occurring problem dimensions. Equifinality allows for the possibility that there can be 'more than one pathway to a given outcome' (Misangyi et al., 2017, p. 256), which is consistent with our context where ecosystems emerge in many formats. Finally, asymmetry of causal relationships allows the possibility that the values of a particular problem dimension in one configuration may be unrelated in another configuration or may have very different values.

Abductive Reasoning

While a configurational approach 'facilitates the exploration of complex models, however, complex configurational models are difficult to specify a priori' (Park and Mithas, 2020; White et al., 2021, p. 6). Besides, as with most social phenomena, not all configurations are practically possible and relevant, a scenario referred to as limited diversity (Ragin, 2009). We use abductive reasoning to elaborate the theory we have described so far by identifying data-driven practically relevant patterns or configurations of the different problem dimensions and platform sponsor scope that enable successful ecosystem emergence. Such an approach to theory building is argued to be a 'practical compromise of induction and deduction [that] more realistically captures the authentic process by which theorizing occurs' (Shepherd and Suddaby, 2017, p. 79).

Abductive reasoning involves forming a conclusion from known information or 'inference to the best explanation' (Kathuria et al., 2020, p. 418) when the 'major premise is evident but the minor premise and therefore the conclusion are only probable' (Merriam-Webster Dictionary, 2020). Abductive reasoning can transparently select the configurations of interest from alternatives (Mantere and Ketokivi, 2013; Van Maanen et al., 2007). We employ abductive reasoning at two stages – first, we employ fuzzy-set qualitative comparative analysis (fsQCA) as the empirical basis (Douglas et al., 2020; Ragin, 2009) to reveal configurations of problem and scope elements. Second, we abduct away (Kathuria et al., 2020) from the fsQCA results and abstract to generate propositions encompassing configurations of problem and scope elements associated with successful ecosystem emergence. Such a two-staged process enables iterating between theory and empirical evidence and progressively develop theory through abductive discovery.

METHODS

fsQCA Technique

In brief, fuzzy-set qualitative comparative analysis (fsQCA) seeks to identify configurations of causal conditions that are related with the outcome of interest based on subset relations between the two across multiple cases (Fiss, 2011; Greckhamer et al., 2008; Ragin, 2009; see Greckhamer et al. (2008) for an in-depth explanation of fsQCA). Using set theory and Boolean minimization, fsQCA can identify the combination of theoretically relevant attributes or causal conditions for the occurrence or non-occurrence of the outcome of interest (Greckhamer et al., 2018). In our context, the procedure helps identify the combination of different problem and platform sponsor scope dimensions for the occurrence or non-occurrence of successful ecosystem emergence. As we explain in the subsequent sections, the initial steps in the procedure involve selection of theoretically relevant cases as samples and the calibration of their degree of membership in the sets of the causal conditions and the outcome.

Research Setting

Our dataset comprises of crowdfunding campaigns to launch digital platforms posted on Kickstarter, the largest crowdfunding site. This dataset is well-suited to answer our

research question for a number of reasons. As a repository of both successful and unsuccessful campaigns, Kickstarter serves as an excellent source of counterfactuals, which is typically difficult to find in the early stages of firms (Mollick, 2014). The detailed campaign information provides insight into how aspiring platform sponsors frame their perspective of the problem to be solved and their choice of platform scope. Furthermore, it has been established that fundraising campaigns on crowdfunding websites like Kickstarter also serve to validate the feasibility of the idea and understand market potential (Elia et al., 2020; Short et al., 2017). In our context, such validation signals the perception of potential complementors and consumers, who as backers indicate their preferences through their funding pledges to the campaigns that propose to launch the platform.

We selected our cases using the following criteria: First, we chose campaigns under the category of 'Technology' and sub-categories of Apps, Web, Hardware and Software that were active during 2016–17. The campaigns listed under the technology category are argued to have a significant technological and scientific component and higher funding goals, both of which make them attractive to professional investors (Roma et al., 2017). Furthermore, we selected only those campaigns that proposed to use digital technologies. Whereas the apps and web categories clearly leverage the technologies of established digital platforms (internet, Apple iOS, Android), the software and hardware categories were manually verified to encompass generativity in their proposed technologies i.e., if they were modular and extendable without affecting the core modules. Second, we selected campaigns that self-described as a platform and met the accepted academic definition of a platform as enabling direct interactions between two or more distinct sides and where each side is affiliated with the platform (Hagiu and Wright, 2015). Third, we selected campaigns that had at least ten backers. Whereas successful campaigns under the Technology category are known to have an average number of backers higher than this threshold (Mollick, 2014), we chose the above threshold as it allows us to capture both successful and unsuccessful campaigns yet include only those that are substantial enough to gather the interest of at least ten distinct backers. We arrived at a dataset of 52 cases or campaigns based on the above criteria.

Measures

The standard fsQCA procedure involves transforming conventional measures (dependent and independent variables) into fuzzy set membership scores by calibrating them against three qualitative thresholds: full membership, the crossover point, and full non-membership. We set thresholds for each measure, based on extant theory and substantial knowledge of the context. Following Ragin (2009), we used the direct method of calibration available in the fsQCA software. Table I summarizes the measures, the fuzzy sets, and their calibration thresholds.

Outcomes

Campaign funding success. We measure campaign success as the ratio of funds raised to the funding goal of the campaign. The primary objective of starting campaigns on Kickstarter is to raise funds in the form of pledges from backers who are then rewarded for their contribution through early access to the platform, products, or other such perks. However,

Table I. Set calibrations and descriptive statistics

	Fuzzy Set Calibrations			*Measure Descriptives*			
Measure/Fuzzy Set	*Fully In*	*Crossover*	*Fully Out*	*Mean*	*SD*	*Max*	*Min*
Well-structured problem	0.8	0.6	0.4	0.72	0.19	1	0.25
High bandwidth channel	1	0.66/0.33	0	0.30	0.38	1	0
High-cost context	80	50	20	70.6	117.9	500	0
Complement decision rights	1	0.66/0.33	0	0.26	0.34	1	0
Narrow scope of sponsor activities	0.6	0.4	0.2	0.48	0.18	1	0.25

the growing literature on crowdfunding has established that in addition to raising funds, crowdfunding campaigns such as those on Kickstarter enable entrepreneurs to conduct an open search for ideas (Stanko and Henard, 2017), engage backers in innovation and product development (Eiteneyer et al., 2019), and collect information on the potential interest of consumers on the product (Viotto da Cruz, 2018). A recent study has thus argued that crowdfunding campaigns help in the 'transition from an abstract idea to a concrete social entity' (Clough et al., 2019, p. 241; Soublière and Gehman, 2020). Hence, with campaign funding success as an outcome variable, we are measuring not just the entrepreneur's success in raising funds but also the interest of potential consumers and complementors, their willingness to suggest ideas and innovation and eventually the creation of a social entity in the form of an ecosystem.

Kickstarter considers a campaign successful when it raises funds equal to or higher than its goal. We calibrated membership in the set of *successful campaigns* using the following thresholds: campaigns that raised funds equal to or higher than their set funding goal were coded as 'fully in' the set of successful campaigns; campaigns that did not raise any funds (i.e., 0 per cent of the set funding goal) were coded as 'fully out' of the set of successful campaigns; and the halfway mark was used as crossover point (i.e., campaigns that raised 50 per cent of the set goal).

Ecosystem emergence. Although Kickstarter campaigns are argued to serve the purposes of early validation, idea generation, and creation of a social entity in addition to raising funds, we supplement our analysis of campaign success with a different outcome variable that explicitly captures ecosystem emergence. *Ecosystem emergence* is the outcome variable that captures if the ecosystem came into being after and as a result of the Kickstarter campaign. We collected data from announcements on Kickstarter and social media pages of the respective campaigns. The ecosystem existence variable is coded 1 if the platform was launched and gained traction through participation of complementors and consumers within one year of the campaign and coded 0 otherwise. We calibrated the set of *ecosystem emergence* using the following typical thresholds of crisp sets: the campaign was coded as 'fully in' when the score was at 1, 'fully out' at 0, and crossover point at 0.5 where the membership was neither fully in nor fully out.

Causal Conditions

Problem structure. The understanding of interdependencies between components of the platform and the complements manifests through the sponsor's identification of initial states, problem-solving approaches, and end states that collectively contribute to the dimension of problem structure. Since Kickstarter allows the campaigns to have free text describing their projects, we captured the presence or absence of the above three elements – initial states, problem-solving approaches, and end states – in the campaigns by posing questions that had binary responses (Yes/No), as summarized in Table II. We calculated the problem structure for each campaign as the ratio of the sum of scores of the above questions to the maximum possible total score, i.e., all questions receive 'Yes' response). We then calibrated the set of *well-structured problem* using the following thresholds: the campaign was coded as 'fully in' when the score was at or above 0.8, 'fully

Table II. Coding scheme for problem structure

Problem structure elements	*Questions (Yes/No)*
Initial state	Is a gap/need identified?
	Have all the sides of the platform been identified?
Problem-solving approaches	Are the activities to be performed by each of the sides identified?
	Does the campaign refer to existing/established platforms or business models?
End state	Is a working solution or prototype provided?

out' at 0.4, and crossover point at 0.6 where the membership was neither fully in nor fully out. We chose these thresholds because a score of 0.8 (4 of the 5 questions received 'Yes') indicates that all three elements have been addressed as at least one question in each element has received a 'Yes' response and a score of 0.4 (2 of the 5 questions received 'Yes') indicates at least one element has not been addressed.

Problem complexity. The magnitude of interdependencies between the platform components and the complements drives the nature of communication between actors and thus the corresponding communication channel bandwidth. Following recommendation from Hsieh et al. (2007), we operationalize problem complexity as the magnitude of bandwidth of the communication channel proposed in the Kickstarter campaign to enable interaction among the platform sponsor and complementors. We coded the campaigns using a four-value fuzzy set of *high bandwidth channel* as follows: campaigns that sought to use in-person or face-to-face or phone calls were coded as fully in this set (1); campaigns that were based on open-source licensing and proposed to follow open-source community practices were coded as more in than out in the set (0.66); campaigns that proposed offering application programming interfaces (APIs) and design manuals to complementors were coded more out than in the set (0.33); and campaigns that only offered online transactions were coded as fully out of the set of high bandwidth channels (0).

Problem context. The complementors engage in experimentation to find valuable complements and thus encounter costs of experimentation that are shaped by the problem context. We measured problem context as the least cost incurred by the complementors to access all available features of the platform to experiment and produce complements. We calibrated membership in the set of *high-cost context* using the following thresholds: Since according to Kickstarter the average pledge amount across all categories is about $80 (Kickstarter, 2019), we coded campaigns that proposed to charge the complementors equal to or more than $80 as fully in the set; campaigns that proposed to charge the complementors less than $20 as fully out of the set; and campaigns that proposed to charge the complementors $50 as the crossover point.

Platform sponsor activities. One of the elements of platform sponsor scope relates to the activities that the sponsor chooses to perform internally. The extent to which these

activities are organized within the firm reflects in the different types of markets that these platforms seek to enable, namely information markets, multisided transaction markets, and complementary innovation markets (Cennamo, 2019). Although digital platforms can encompass a combination of these markets, the distinct types can help identify the distinct activities of the platform. In enabling information markets, the platform serves as an 'information channeling infrastructure that enables the categorization and search of relevant information, and facilitates users' exchange of information and matching' (Cennamo, 2019, p. 8). We identified that the activities underpinning information markets are information exchange and matching or categorization of information. In multisided transaction markets, the platform provides the 'infrastructure to connect providers of goods and services with final customers, and facilitate value-exchange transactions among them' (Cennamo, 2019, p. 6). Thus, the activities underpinning multisided transaction markets are trading, matching demand and supply, and enabling competition. In complementary innovation markets, the platform provides a 'common assets' infrastructure for innovation, making sure that complementarity and product system integration are achieved *ex ante*' to enable the complementors to extend the platform functionality (Cennamo, 2019, p. 7). Consequently, the primary activities underpinning complementary innovation markets are group-level coordination of complementors to generate and commercialize innovation.

Overall, we identified the key activities underpinning each of the above three markets as – information exchange, matching, trading, competition, and group-level coordination. When most of these above-mentioned activities are encompassed within the platform rather than being internal to the sponsor firm, then it follows that the platform sponsor has retained few activities to be performed internally (Hagiu and Wright, 2015) and therefore has a narrow scope. We coded each campaign for the activities they propose to perform from the above list. The presence of an activity was coded as 1 or 0 otherwise. We then calculated the platform sponsor scope as the ratio of the sum of the activities performed by the platform to the maximum score of 5 when all activities are proposed. Next, we calibrated the set of *narrow scope of activities* using the following thresholds: the campaign was coded as 'fully in' when the score was at or above 0.6, 'fully out' at 0.2, and crossover point at 0.4 where the membership was neither fully in nor fully out. We chose the above conservative threshold for full membership in the set of *narrow scope of activities* as the combination of any three activities requires the platform to forego control over key parts of the value creation process.

Complement decision rights. The decision rights of the complements can remain with the complementors, within a subgroup or community, or with the platform sponsors. The campaigns on Kickstarter provide this information as it indicates the possible ways backers can capture value in addition to the rewards laid out as part of the campaign. We coded the campaigns using a four-value fuzzy set of *platform sponsor's decision rights on complements* as follows: campaigns that proposed to centrally hold decision rights over complements were coded as fully in this set (1); campaigns where the decision rights of the complements resided within platform sponsor-identified clusters or subgroups were coded as more in than out in the set (0.66); campaigns that proposed distributing the decision rights within the community were coded more out than

in the set (0.33); and campaigns that allowed the complementors to retain decision rights were coded as fully out of the set of platform sponsor's decision rights on complements (0).

Data Analysis

We used the standard fsQCA software 3.0 to perform our analyses. As a first step we sought to identify any necessary conditions, which are the causal conditions that must be present for an outcome to occur. We conducted necessity analyses of all conditions and their negation using the recommended benchmark of 0.9 for consistency scores (Greckhamer et al., 2018; Ragin, 2009). We did not find any necessary conditions from our dataset. Next, we conducted sufficiency analyses using the Quine–McCluskey algorithm to logically minimize from all possible combinations. The results of the sufficiency analyses identified configurations of conditions consistently linked to an outcome. Following recommended guidelines for an intermediate-N dataset like ours, we chose a minimum frequency threshold for a configuration's inclusion in causal analyses as 1, which included 80 per cent of our cases (Greckhamer et al., 2013). We applied a consistency threshold of ≥0.8 and a PRI (proportional reduction in inconsistency) of ≥0.7, as recommended for analyses involving fuzzy sets. We performed the sufficiency analyses for both the outcome and non-outcome using the same thresholds and cut-offs.

RESULTS

Tables III–V summarize the results of the fsQCA analyses using the standard notation (Ragin, 2009) for the occurrence and non-occurrence of the outcomes. In each configuration, the full circles indicate the presence of a condition, and the crossed-out circles indicate the absence of a condition. Further, the larger circles indicate core conditions that occur in both the parsimonious and intermediate solutions and thus indicate strong causal relationship. The smaller circles indicate peripheral conditions that occur only in intermediate solutions and thus indicate weak causal relationships (Fiss, 2011).

We report in Tables III–V standard measures of consistency, raw coverage, and unique coverage for each of the configurations as well as overall consistency and coverage for the solution formula. The consistency score is a measure of the number of cases consistent with the outcome and is calculated as the ratio of number of cases that exhibit the configuration of causal conditions and the outcome to the number of cases that exhibit the configuration of causal conditions but not the outcome (Ragin, 2009). The coverage score is a measure of the empirical importance of a configuration and is calculated as the percentage of cases that follow a given pathway to the outcome (Fiss, 2011). Our results show that the overall solution consistency is 0.86 (coverage of 0.48) for the outcome of successfully funded campaigns and 0.78 (coverage of 0.36) for ecosystem existence, both exceeding recommended threshold for consistency scores. We first present the various results, following which we derive select insights and abduct away (Kathuria et al., 2020) to offer propositions.

Table III. Configurations of successfully funded campaigns

Configurations of Successfully Funded Campaigns

Taxonomy of Digital Platform Ecosystems	**Complementary Innovation Ecosystems**		**Open Source Ecosystems**		**Information ecosystems**
Search process and platform sponsor scope alignment	*(Semi-directed search and broad scope)*		*(Community-directed search and less broad scope)*		*(Orchestrated-undirected search and narrow scope)*
Solution	**1a**	**1b**	**2**	**3**	**4**
Problem dimensions					
Well-structured problem	⊗	⊗		⊗	●
High complexity		●	●	●	⊗
High-cost context	●	●	⊗		●
Platform sponsor scope					
Complement decision rights	●		⊗	⊗	
Narrow scope of activities	⊗	⊗	⊗	⊗	●
Consistency	0.87	0.87	0.92	0.90	0.82
Raw Coverage	0.14	0.15	0.22	0.23	0.14
Unique Coverage	0.02	0.01	0.04	0.01	0.21
Overall Solution Consistency		**0.86**			
Overall Solution Coverage		**0.48**			

Configurations of Successfully Funded Campaigns

Solutions represented in the columns of Table III represent the configurations related to the outcome of successful campaigns. Solution 1a (consistency score of 0.87 and raw coverage of 0.14) shows that campaigns were successfully funded when they proposed to solve problems that were not well-structured in a high-cost context as long as they also proposed to retain both a high platform sponsor scope and decision rights over complements. Solution 1b (consistency score of 0.87 and raw coverage of 0.15) shows that campaigns were successfully funded when they proposed to solve problems that were not well-structured and highly complex in a high-cost context as long as the platform sponsor retained a broad scope of activities. In both solution 1a and 1b the conditions of not well-structured problems and high-cost context are core conditions.

Solution 2 (consistency score of 0.92 and raw coverage of 0.22) shows that campaigns were successfully funded when they proposed to solve problems that were highly complex in a low-cost context when the platform sponsor scope of activities was broad, but the sponsor did not exert decision rights over the complements. All the conditions appeared as core conditions. Solution 3 (consistency score of 0.9 and raw coverage of 0.23) shows that campaigns were successfully funded when they proposed to solve high complexity problems that are not well-structured and combined them with distributed decision

Table IV. Configurations for ecosystem emergence

Configurations for Ecosystem Emergence

Taxonomy of Digital Platform Ecosystems	**Open Source Ecosystems**		**Information ecosystems**
Search process and platform sponsor scope alignment	*(Community-directed search and less broad scope)*		*(Orchestrated-undirected search and narrow scope)*
Solution	**5**	**6**	**7**
Problem dimensions			
Well-structured problem		⊗	●
High complexity	●	●	⊗
High-cost context	⊗		●
Platform sponsor scope			
Complement decision rights	⊗	⊗	●
Narrow scope of activities	⊗	⊗	●
Consistency	0.78	0.77	0.91
Raw Coverage	0.23	0.25	0.13
Unique Coverage	0.05	0.06	0.05
Overall Solution Consistency		**0.78**	
Overall Solution Coverage		**0.36**	

rights while retaining a high share of activities. Finally, solution 4 (consistency score of 0.82 and raw coverage of 0.14) shows that campaigns were funded when they proposed to solve well-structured and simple problems but in a high-cost context as long as the platform sponsor retained a narrow set of activities.

Configurations for Successful Ecosystem Emergence

Solutions 5 to 7 in Table IV depict the outcome of successful ecosystem emergence, as distinct from successful funding. Solution 5 (consistency score of 0.78 and raw coverage of 0.235) represents a configuration that is identical to solution 2 in Table III, where the outcome was successful funding of the campaign. Solution 6 (consistency score of 0.77 and raw coverage of 0.25) is similar to solution 3 in Table III, the one difference being that the former depicts all conditions as core conditions whereas the latter had all peripheral conditions. Finally, solution 7 is similar to solution 4 with an additional condition of the platform sponsor exerting decision rights of complements as a core condition of the causal recipe. Such tight overlap of the solutions across the two outcomes validates the argument that a successful funding may also indicate progress in the emergence of the ecosystem.

Table V. Configurations for negation of outcomes

Configurations for Negation of Outcomes

Outcome	Not funded	No Ecosystem existence				
Solution	8	9	10	11	12	13
Problem dimensions						
Well-structured problem	●	⊗	●		•	●
High complexity	●	⊗		●	•	●
High-cost context	●	⊗	●	⊗	⊗	•
Platform sponsor scope						
Complement decision rights	⊗		⊗	●	•	●
Narrow scope of activities		•	⊗	●	•	●
Consistency	0.83	0.84	0.83	0.90	0.87	0.88
Raw Coverage	0.22	0.17	0.15	0.22	0.14	0.11
Unique Coverage	0.22	0.07	0.06	0.10	0.06	0.04
Overall Solution Consistency				**0.88**		
Overall Solution Coverage				**0.48**		

Not Successful Campaigns

Table V summarizes the configurations related to the non-occurrence of the outcomes of successful funding of campaigns and ecosystem emergence. Solution 8 (consistency score of 0.83 and raw coverage of 0.22) shows that campaigns were not successfully funded when they proposed to solve problems that were well-structured and highly complex in a high-cost context and the platform sponsor proposed to not exert decision rights over the complements. Solution 9-13 (consistency score of 0.88 and raw coverage of 0.48) shows the configurations where the campaigns failed to launch platforms and facilitate ecosystem emergence. These configurations do not have any overlap with the configurations for successful funding and ecosystem emergence depicted in Tables III and IV. Furthermore, as we argued in our theory, the configurations in solutions 9-13 of Table V depict a mismatch between the problem dimensions and platform sponsor scope. Whereas solutions 11, 12, and 13 show recipes of the platform sponsor retaining a narrow scope and exerting decision rights over complements, the problem dimensions move the search towards a more semi-directed process, thereby creating a misalignment. Solution 10 also suffers from a misalignment between a broad scope with complement decision rights and problem dimensions requiring an undirected search process. In contrast, solution 9 suffers from a misalignment between a narrow scope and problem requiring cognitive guidance of the sponsor.

Finally, we conducted a number of sensitivity analyses to examine the robustness of our findings (results available on request). We considered alternative crossover points by varying the crossover points for all measures by ±25 per cent. Although minor changes appear in the solution in the form of the number of solutions and sub-solutions, the interpretation of the results remain unchanged indicating the robustness of the findings.

PATHWAYS TO ECOSYSTEM EMERGENCE

We expected an alignment between the problem dimensions and platform sponsor scope to enable ecosystem emergence but relied on abductive reasoning to identify the exact configurations of problem dimensions and scope. In the results section above, we discussed such configurations where the campaign was successfully funded and led to ecosystem emergence as well as those that did not receive sufficient funding and did not emerge as an ecosystem. Following prior studies (Kathuria et al., 2020), we now abduct away from the individual configurations to offer generic propositions encompassing pathways to ecosystem emergence. We employ a taxonomy of ecosystems as our baseline for interpreting the empirical results and draw on substantial and case knowledge (Ragin, 2009) to abstract from the configurations and highlight alignment between platform sponsor scope and search process.

Complementary Innovation Ecosystems

Platform ecosystems have been exhaustively studied as innovation engines 'providing the core technological architecture other firms build upon to create new products that extend the core functionality and reach of the platform to final users' (Cennamo, 2019, p. 7; Gawer, 2014). Examples of such ecosystems include the Apple iOS ecosystem and SAP NetWeaver computing ecosystem. The primary source of value in such platforms comes from the platform offerings that are then enhanced by complementing products (McIntyre and Srinivasan, 2017). As a result, the platform sponsors play a wider role in the value creation process and exert considerable influence on the solutions to the problems. Such broad scope of activities allows the platform sponsors to better understand the interdependencies among the different modules and thereby become better equipped to solve ill-structured problems. The interdependencies sometimes requires that the sponsor retain decision rights over the complements for better absorption into the value propositions. The search process in solving such problems would tend to be a more semi-directed one that is aligned with a broad platform sponsor scope, as depicted in Figure 2. Also, the platform sponsors can charge the complementors a higher price for allowing access to the core infrastructure and reach to final users, which is often valuable to the complementors, and thereby make the problem context more constrained for experimentation (Weyl, 2010). These observations are found in the configurations of solution 1a and 1b (Table III) in our results and can be summarized as in the proposition below:

> *Proposition 1*: The emergence of complementary innovation ecosystems is associated with solving ill-structured, complex problems in a high-cost context where the platform sponsor retains a broad set of activities to perform internally and holds decision rights over the complements.

Open-Source Platform Ecosystems

Comparing the configurations of solution 2 and 3 (Table III) as well as solution 5 and 6 (Table IV) with the cases representing these configurations, we found that both these

configurations correspond to campaigns aimed at building open-source platforms. Digital technologies have enabled the rise of open-source hardware and software platforms that foster open innovation, which is a 'distributed innovation process based on purposively managed knowledge flows across organizational boundaries' (Chesbrough and Bogers, 2014, p. 17). Examples of such ecosystems include Mozilla and Linux open-source software ecosystems. Value creation in the ecosystems around such platforms is dependent on the contribution of participating complementors as well as on the management of these contributions to form a coherent and valuable solution to the problem. Hence, a less-constrained problem context is fundamental to such ecosystems so that complementors can experiment easily and contribute to the solution.

The platform sponsors retain a broad scope of activities to enable the creation of coherent solutions from the contributions of complementors. Notably, the underlying premise of these ecosystems is that the decision rights to the solutions rest within the community of contributors and the solutions are often free for everyone to use (Bogers et al., 2017). Thus, the platform sponsor scope is less broad than that in the complementary innovation ecosystem discussed above. With such a scope choice, the platform sponsors open the core infrastructure and seek solutions to complex ill-structured problems. We refer to the search process for solving such problems as a community-directed search (Figure 2) that is less dependent on the sponsor yet not undirected. Thus, as shown in the configurations of solution 2 and 3, open-source ecosystems depict the problem and scope configurations as summarized in the following proposition:

> *Proposition 2*: The emergence of open-source ecosystems is associated with solving highly complex and ill-structured problems in a low-cost context where the platform sponsor retains a broad set of activities to perform internally but does not exert decision rights over complements.

Information Ecosystems

The configurations of solution 4 (Table III) and solution 7 (Table IV) in the results represent cases that can be described as information ecosystems, where the platform primarily serves as an 'information channeling infrastructure that enables the categorization and search of relevant information, and facilitates users' exchange of information and matching' (Cennamo, 2019, p. 8). Examples of such ecosystems include Google's search engine, LinkedIn, and Slack messaging platforms. The primary sources of value in these ecosystems are: one, the platform infrastructure that allows for a reliable and accurate matching of relevant information; and two, the information that is often generated by the complementors of the platform. The complementors of information ecosystems include, on one hand, advertisers and content creators who rely on the platform infrastructure to match with the right target users and, on the other hand, the users who generate information for other users on the platform. Since the complementors are engaged in solving the problem of targeting the right users with right information and the platform sponsors provide the tools to filter and match relevant information, the problem being solved is a well-structured one with known initial and end states and formalized problem-solving

procedures. Thus, the search process may be undirected yet orchestrated by the platform sponsor (Figure 2).

At the same time, the sponsor retains control over the information generated to enhance its matching tools and provide better targets to the complementors. In our terminology, this shows that the platform sponsors exert decision rights over the complements. Though the platform sponsors provide the core infrastructure for matching, they do not engage in activities of creating the information or in disseminating them. Hence, the platform sponsors can retain a narrow scope of activities and facilitate the complementors to perform other activities for value creation (Figure 2). However, despite their narrow scope the platform sponsors can charge a high price and constrain access to the platform, the information, and the users as they exert decision rights on the overall solution. The above findings may be summarized in the following proposition:

> *Proposition 3*: The emergence of information ecosystems is associated with solving well-structured and simple problems in a high-cost context where the platform sponsor retains a narrow set of activities to perform internally and holds decision rights over complements.

DISCUSSION

In this paper we demonstrated how a digital platform sponsor's choice of scope vis-à-vis complementors can facilitate the emergence of an ecosystem around its platform. The context of digital platforms being similar to that of knowledge, we extended the problem-solving perspective to explain how two distinct decisions – problem to be solved and platform sponsor scope – have implications for the successful emergence of an ecosystem of complementors and consumers. Since the configuration of problem dimensions influence aspects of the search process, as the PSP suggests, governing such a search process suitably to overcome hazards of value creation is essential to identify valuable solutions efficiently. However, the governance of the search is constrained by the scope of the platform sponsor. Hence, we considered both problem dimensions and platform sponsor scope in our analysis of ecosystem emergence. Using a configurational perspective, we showed that an alignment between the problem dimensions and the platform sponsor's scope facilitates an efficient search and thereby attract autonomous complementors and consumers, leading to the emergence of an ecosystem.

Our paper makes a number of theoretical and empirical contributions to both the platform and the problem-solving perspective literatures. First, it sheds light on the underexplored topic of how platform sponsors can facilitate the emergence of digital platform ecosystems in the incipient stages. Through its distinct focus and logic, the paper complements the stream of studies arguing that managers aspiring to build ecosystems must consider the benefits for ecosystem users as a way of attracting them to participate (Gawer, 2011; Thomas et al., 2014). Our findings highlight a novel set of considerations – problem dimensions and platform sponsor's scope choices – to tackle the early-stage challenge of attracting autonomous actors to participate and contribute to an incipient

less-known platform ecosystem. Our theoretical framework of alignment between problem and scope for efficient search, supported by empirical evidence encompassing distinct configurations of these two dimensions, demonstrates how platform sponsors can attract participation and thus enable ecosystem emergence. We also contribute to the firm scope literature by demonstrating that, in the context of digital platform ecosystems, selective decision rights over complements are a facet of scope choice in addition to ownership.

Second, by establishing that the context of digital platforms is similar to that of knowledge, we extend the problem-solving perspective to platform ecosystems. As we have demonstrated in this paper, the problem-solving perspective is useful to examine how the micro-level aspects of problem and sponsor scope link with broader ecosystem-level considerations (Felin and Zenger, 2014). The problem-solving perspective and problem as the unit of analysis is helpful to address innate challenges in studying digital platform ecosystems and more broadly digital strategy. For example, the difficulty in tracking ex-ante unknown complementors (Gawer and Cusumano, 2014) is a major reason why research on ecosystem emergence has remained scant (Dattée et al., 2018). The focus on the value proposition (Adner, 2017) also suffers from a similar drawback as it assumes that the value proposition is known ex-ante whereas in most cases the value proposition evolves as more complements are offered to consumers. We demonstrate that applying 'problem' as a unit of analysis in ecosystems helps overcome the challenges in explaining emergence of ex-ante unknown actors in the ecosystem as it is not required to know '*who*' solves the problem, rather it is sufficient to know '*what*' problem is being solved. Our approach shows how we can study issues pertinent to digital strategy without knowing or tracking these multiple actors.

Third, our study is among the few to employ abductive reasoning for theory development (for a detailed discussion see Kathuria et al., 2020 and Shepherd and Subbady, 2017) in combination with a configurational approach (Misangyi et al., 2017). In empirically identifying a new search process – community-driven search – we demonstrate the benefits of such an analytical approach where abductive logic can refine and bring granularity to theory using empirical evidence. By using a configurational approach to understand the implications of the problem dimensions and platform sponsor scope choice, we established that there are multiple pathways to successful emergence so long as there is an alignment between the problem and scope. The result of equifinality in outcomes underscores that digital platform ecosystems can emerge in multiple forms and types. Fundamental to our configurational alignment argument is the inherent trade-offs that managers face at the outset in choosing their scope in accordance with the problem dimensions. In identifying the configurations of the three distinct ecosystem types, our study provides exemplars of such trade-offs and thereby the pathways to ecosystem emergence. Furthermore, by employing an analytical strategy combining a configurational approach alongside problem-solving perspective, we have demonstrated the importance of studying different problem dimensions holistically as they shape the search process together, a finding that has implications for the problem-solving perspective.

Our study is not without limitations. Firstly, we coded our measures based on the free-form text of the campaigns. Although care has been exercised to use objective criteria for coding the conditions, there is scope to use a dataset that provides more objective measures for problem structure and platform sponsor scope to further test our arguments.

Whereas the QCA technique allowed us to handle the subjectivity involved in these measures, future studies may benefit by considering the implications of subjective measures if a large sample is involved. Relatedly, although we have employed a crisp set of successful ecosystem emergence outcome in addition to the fuzzy set of campaign funding success, the outcomes may not fully capture the potential complementors' interest in the platform ecosystem as they are closely aligned to success in raising funds through crowdfunding. Future studies can address this limitation by employing objective measures of ecosystem emergence such as number of participants on each side of the platform or number of complements. However, such attempts should employ measures that are comparable across the different types of platform ecosystems under study. Furthermore, we restricted our analysis of ecosystem emergence to one year after the end of the Kickstarter campaign in order to capture the impact of problem dimensions and scope alignment proposed in the campaign. Future work may examine these relationships over a longer period of time and in particular examine the evolution of these configurations.

Secondly, although we expected an alignment between problem dimensions and platform sponsor scope, we relied on fsQCA analyses to identify the ideal configurations. Consequently, we did not find consistent configurations for multi-sided transaction platforms from our dataset. A closer examination of the dataset revealed that the inconsistencies emerged from the apps and web categories that had a very low-cost context. Future studies can explore the reasons for varied problem configurations for multi-sided transaction platforms and the underlying reasons for the inconsistencies in low-cost contexts. Thirdly, the scope of this study was limited to explaining the scope decisions of platform sponsors of ecosystems that emerge as a deliberate action. Future work can contrast such ecosystems with ones that emerge in a non-deliberate manner or as communities. Furthermore, our study focused only on governance of search processes and thus restricted itself to scope in terms of activities and decision rights. There is also room to consider other governance aspects such as monetization methods, incentives, and subsidies. Finally, our study focused on the early stage of ecosystem emergence. Future work can identify how these ecosystems survive and grow over a period of time and how problem configurations and scope choices change with time.

In conclusion, with the proliferation of platform ecosystems, there is a need for more research that focuses on the incipient stage to better understand how platform sponsors can enable the emergence of platform ecosystems. As we demonstrated, the problem-solving perspective has immense potential to deepen insight into the strategic choices available to lesser known platform sponsors and their implications. We see much promise in this stream of research to advance theory at the intersection of platform ecosystems and entrepreneurship, as well as provide practically relevant knowledge.

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REFERENCES

Adner, R. (2017). 'Ecosystem as structure: An actionable construct for strategy'. *Journal of Management*, **43**, 39–58.

Adner, R. and 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**, 306–33.

Afuah, A. and Tucci, C. L. (2012). 'Crowdsourcing as a solution to distant search'. *Academy of Management Review*, **37**, 355–75.

Ahuja, G. and Novelli, E. (2017). 'Redirecting research efforts on the diversification-performance linkage: The search for synergy'. *Academy of Management Annals*, **11**, 342–90.

Autio, E. and Thomas, L. D. W. (2020). 'Value co-creation in ecosystems: Insights and research promise from three disciplinary perspectives'. In Nambisan, S., Lyytinen, K. and Yoo, Y. (Eds), *Handbook of Digital Innovation*. Cheltenham: Edward Elgar Publishing Limited, 107–132.

Baldwin, C. Y. and Clark, K. B. (2006). 'The architecture of participation: Does code architecture mitigate free riding in the open source development model?'. *Management Science*, **52**, 1116–27.

Bogers, M., Zobel, A.-K., Afuah, A., Almirall, E., Brunswicker, S., Dahlander, L., Frederiksen, L., Gawer, A., Gruber, M., Haefliger, S., Hagedoorn, J., Hilgers, D., Laursen, K., Magnusson, M. G., Majchrzak, A., McCarthy, I. P., Moeslein, K. M., Nambisan, S., Piller, F. T., Radziwon, A., Rossi-Lamastra, C., Sims, J. and Ter Wal, A. L. J. (2017). 'The open innovation research landscape: Established perspectives and emerging themes across different levels of analysis'. *Industry and Innovation*, **24**, 8–40.

Boudreau, K. J. (2010). 'Open platform strategies and innovation: Granting access vs. devolving control'. *Management Science*, **56**, 1849–72.

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**, 1409–27.

Boudreau, K. J. and Hagiu, A. (2009). 'Platform rules: Multi-sided platforms as regulators'. In Gawer, A. (Ed), *Platforms, Markets and Innovation*. Cheltenham: Edward Elgar Publishing, 163–181.

Caillaud, B. and Jullien, B. (2003). 'Chicken & egg: Competition among intermediation service providers'. *The RAND Journal of Economics*, **34**, 309–28.

Ceccagnoli, M., Forman, C., Huang, P. and Wu, D. J. (2012). 'Cocreation of value in a platform ecosystem! The case of enterprise software'. *MIS Quarterly*, **36**, 263–90.

Cennamo, C. (2018). 'Building the value of next-generation platforms: The paradox of diminishing returns'. *Journal of Management*, **44**, 3038–69.

Cennamo, C. (2021). 'Competing in digital markets: A platform-based perspective'. *Academy of Management Perspectives*, **35**, 265–91. https://doi.org/10.5465/amp.2016.0048

Cennamo, C., Ozalp, H. and Kretschmer, T. (2018). 'Platform architecture and quality trade-offs of multihoming complements'. *Information Systems Research*, **29**, 461–78.

Cennamo, C. and Santalo, J. (2013). 'Platform competition: Strategic trade-offs in platform markets: Platform competition'. *Strategic Management Journal*, **34**, 1331–50.

Cennamo, C. and Santaló, J. (2019). 'Generativity tension and value creation in platform ecosystems'. *Organization Science*, **30**, 617–41.

Chesbrough, H. and Bogers, M. (2014). Explicating Open Innovation: Clarifying an Emerging Paradigm for Understanding Innovation. *New Frontiers in Open Innovation*. SSRN Scholarly Paper ID 2427233. Forthcoming. Oxford: Oxford University Press, 3–28.

Choudary, S. P., Alstyne, M. W. V. and Parker, G. G. (2016). *Platform Revolution: How Networked Markets Are Transforming the Economy–and How to Make Them Work for You*. New York: W. W. Norton & Company.

Clough, D. R., Fang, T. P., Vissa, B. and Wu, A. (2019). 'Turning lead into gold: How do entrepreneurs mobilize resources to exploit opportunities?'. *Academy of Management Annals*, **13**, 240–71.

Constantinides, P., Henfridsson, O. and Parker, G. G. (2018). 'Introduction – Platforms and infrastructures in the digital age'. *Information Systems Research*, **29**, 381–400.

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

Dattée, B., Alexy, O. and Autio, E. (2018). 'Maneuvering in poor visibility: How firms play the ecosystem game when uncertainty is high'. *Academy of Management Journal*, **61**, 466–98.

Douglas, E. J., Shepherd, D. A. and Prentice, C. (2020). 'Using fuzzy-set qualitative comparative analysis for a finer-grained understanding of entrepreneurship'. *Journal of Business Venturing*, **35**, 1–17. https://doi.org/10.1016/j.jbusvent.2019.105970

Eiteneyer, N., Bendig, D. and Brettel, M. (2019). 'Social capital and the digital crowd: Involving backers to promote new product innovativeness'. *Research Policy*, **48**, 1–15. https://doi.org/10.1016/j.respol.2019.01.017

Elia, G., Margherita, A. and Passiante, G. (2020). 'Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process'. *Technological Forecasting and Social Change*, **150**, 1–12. https://doi.org/10.1016/j.techfore.2019.119791

Fang, T. P., Wu, A. and Clough, D. R. (2021). 'Platform diffusion at temporary gatherings: Social coordination and ecosystem emergence'. *Strategic Management Journal*, **42**, 233–272. https://doi.org/10.1002/smj.3230

Felin, T. and Zenger, T. R. (2014). 'Closed or open innovation? Problem solving and the governance choice'. *Research Policy*, **43**, 914–25.

Fiss, P. C. (2011). 'Building better causal theories: A fuzzy set approach to typologies in organization research'. *Academy of Management Journal*, **54**, 393–420.

Furnari, S., Crilly, D., Misangyi, V. F., Greckhamer, T., Fiss, P. C. and Aguilera, R. (2020). 'Capturing causal complexity: Heuristics for configurational theorizing'. *Academy of Management Review*. https://doi.org/10.5465/amr.2019.0298

Furr, N., Nickerson, J. A. and Wuebker, R. (2016). *Governing The Search For Value: A Preliminary Theory of Entrepreneuring*. INSEAD Working Paper No. 2016/16/STR. Available at SSRN: https://ssrn.com/abstract=2747458 or http://dx.doi.org/10.2139/ssrn.2747458

Gawer, A. (2011). *Platforms, Markets and Innovation*. Cheltenham: Edward Elgar Publishing.

Gawer, A. (2014). 'Bridging differing perspectives on technological platforms: Toward an integrative framework'. *Research Policy*, **43**, 1239–49.

Gawer, A. and Cusumano, M. A. (2014). 'Industry platforms and ecosystem innovation'. *Journal of Product Innovation Management*, **31**, 417–33.

Gawer, A. and Henderson, R. (2007). 'Platform owner entry and innovation in complementary markets: Evidence from intel'. *Journal of Economics & Management Strategy*, **16**, 1–34.

Greckhamer, T., Furnari, S., Fiss, P. C. and Aguilera, R. V. (2018). 'Studying configurations with qualitative comparative analysis: Best practices in strategy and organization research'. *Strategic Organization*, **16**, 482–95.

Greckhamer, T., Misangyi, V., Elms, H. and Lacey, R. (2008). 'Using qualitative comparative analysis in strategic management research: An examination of combinations of industry, corporate, and business-unit effects'. *Organizational Research Methods*, **11**, 695–726.

Greckhamer, T., Misangyi, V. F. and Fiss, P. C. (2013). 'Chapter 3 The two QCAs: From a small-N to a large-N set theoretic approach'. In Fiss, P. C., Cambré, B. and Marx, A. (Eds), *Research in the Sociology of Organizations*. Bingley: Emerald Group Publishing Limited, **38**, 49–75.

Gulati, R., Wohlgezogen, F. and Zhelyazkov, P. (2012). 'The two facets of collaboration: Cooperation and coordination in strategic alliances'. *Academy of Management Annals*, **6**, 531–83.

Hagiu, A. and Wright, J. (2015). 'Marketplace or reseller?'. *Management Science*, **61**, 184–203.

Hagiu, A. and Wright, J. (2019). 'Controlling vs. enabling'. *Management Science*, **65**, 577–95.

Hagiu, A. and Yoffie, D. B. (2009). 'What's Your Google Strategy?'. *Harvard Business Review*, **87**, 74–81.

Hannah, D. P. and Eisenhardt, K. M. (2018). 'How firms navigate cooperation and competition in nascent ecosystems'. *Strategic Management Journal*, **39**, 3163–92.

Hayek, F. A. (1945). 'The use of knowledge in society'. *The American Economic Review*, **35**, 519–30.

Heiman, B. A. and Nickerson, J. A. (2004). 'Empirical evidence regarding the tension between knowledge sharing and knowledge expropriation in collaborations'. *Managerial and Decision Economics*, **25**, 401–20.

Helfat, C. E. and Raubitschek, R. S. (2018). 'Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems'. *Research Policy*, **47**, 1391–99.

Hippel, E. V. and von Krogh, G. (2015). 'CROSSROADS – Identifying viable "need–solution pairs": Problem solving without problem formulation'. *Organization Science*, **27**, 207–21.

Hsieh, C., Nickerson, J. A. and Zenger, T. R. (2007). 'Opportunity discovery, problem solving and a theory of the entrepreneurial firm'. *Journal of Management Studies*, **44**, 1255–77.

Iansiti, M. and Levien, R. (2004). 'Strategy as ecology'. *Harvard Business Review*, **82**, 68–78.

Jeppesen, L. B. and Frederiksen, L. (2006). 'Why do users contribute to firm-hosted user communities? The case of computer-controlled music instruments'. *Organization Science*, **17**, 45–63.

Jeppesen, L. B. and Lakhani, K. R. (2010). 'Marginality and problem-solving effectiveness in broadcast search'. *Organization Science*, **21**, 1016–33.

Jerath, K. and Zhang, Z. J. (2010). 'Store within a Store'. *Journal of Marketing Research*, **47**, 748–63.

Jonassen, D. H. (2004). *Learning to Solve Problems: An Instructional Design Guide*. San Francisco: Pfeiffer, John Wiley & Sons, Inc.
Kapoor, R. (2018). 'Ecosystems: Broadening the locus of value creation'. *Journal of Organization Design*, **7**, 12.
Kapoor, R. and Lee, J. M. (2013). 'Coordinating and competing in ecosystems: How organizational forms shape new technology investments'. *Strategic Management Journal*, **34**, 274–96.
Kathuria, A., Karhade, P. P. and Konsynski, B. R. (2020). 'In the realm of hungry ghosts: Multi-level theory for supplier participation on digital platforms'. *Journal of Management Information Systems*, **37**, 396–430.
Kickstarter. (2019). *Kickstarter Stats*. Available at https://www.kickstarter.com/help/stats?ref=global-footer (accessed 26 November 2019).
Macher, J. T. (2006). 'Technological development and the boundaries of the firm: A knowledge-based examination in semiconductor manufacturing'. *Management Science*, **52**, 826–43.
Macher, J. T. and Boerner, C. (2012). 'Technological development at the boundaries of the firm: A knowledge-based examination in drug development'. *Strategic Management Journal*, **33**, 1016–36.
Mantere, S. and Ketokivi, M. (2013). 'Reasoning in organization science'. *Academy of Management Review*, **38**, 70–89.
McIntyre, D. P. and Srinivasan, A. (2017). 'Networks, platforms, and strategy: Emerging views and next steps'. *Strategic Management Journal*, **38**, 141–60.
McIntyre, D. P., Srinivasan, A., Afuah, A., Gawer, A. and Kretschmer, T. (2020). 'Multi-sided platforms as new organizational forms'. *Academy of Management Perspectives*. https://doi.org/10.5465/amp.2018.0018
McIntyre, D. P. and Subramaniam, M. (2009). 'Strategy in network industries: A review and research agenda'. *Journal of Management*, **35**, 1494–517.
Meyer, A. D., Tsui, A. S. and Hinings, C. R. (1993). 'Configurational approaches to organizational analysis'. *Academy of Management Journal*, **36**, 1175–95.
Misangyi, V. F., Greckhamer, T., Furnari, S., Fiss, P. C., Crilly, D. and Aguilera, R. (2017). 'Embracing causal complexity: The emergence of a neo-configurational perspective'. *Journal of Management*, **43**, 255–82.
Mollick, E. (2014). 'The dynamics of crowdfunding: An exploratory study'. *Journal of Business Venturing*, **29**, 1–16.
Nickerson, J. A., Silverman, B. S. and Zenger, T. R. (2007). 'The "problem" of creating and capturing value'. *Strategic Organization*, **5**, 211–25.
Nickerson, J. A., Yen, C. J. and Mahoney, J. T. (2012). 'Exploring the problem-finding and problem-solving approach for designing organizations'. *Academy of Management Perspectives*, **26**, 52–72.
Nickerson, J. A. and Zenger, T. R. (2004). 'A knowledge-based theory of the firm – The problem-solving perspective'. *Organization Science*, **15**, 617–32.
Ozalp, H. and Kretschmer, T. (2019). 'Follow the crowd or follow the trailblazer? The differential role of firm experience in product entry decisions in the US video game industry'. *Journal of Management Studies*, **56**, 1452–81.
Park, Y. K. and Mithas, S. (2020). 'Organized complexity of digital business strategy: A configurational perspective'. *MIS Quarterly*, **44**, 85–127.
Parker, G. G. and Van Alstyne, M. W. (2017). 'Innovation, openness, and platform control'. *Management Science*, **64**, 3015–32.
Ragin, C. C. (2009). *Redesigning Social Inquiry: Fuzzy Sets and Beyond*. Chicago: University of Chicago Press.
Rietveld, J., Ploog, J. N. and Nieborg, D. B. (2020). 'The coevolution of platform dominance and governance strategies: Effects on complementor performance outcomes'. *Academy of Management Discoveries*, **6**, 488–513. https://doi.org/10.5465/amd.2019.0064
Roma, P., Messeni Petruzzelli, A. and Perrone, G. (2017). 'From the crowd to the market: The role of reward-based crowdfunding performance in attracting professional investors'. *Research Policy*, **46**, 1606–28.
Schilling, M. A. (2002). 'Technology success and failure in winner-take-all markets: The impact of learning orientation, timing, and network externalities'. *Academy of Management Journal*, **45**, 387–98.
Shepherd, D. A. and Suddaby, R. (2017). 'Theory building: A review and integration'. *Journal of Management*, **43**, 59–86.
Short, J. C., Ketchen, D. J., McKenny, A. F., Allison, T. H. and Ireland, R. D. (2017). 'Research on crowdfunding: Reviewing the (very recent) past and celebrating the present'. *Entrepreneurship Theory and Practice*, **41**, 149–60.
Soublière, J.-F. and Gehman, J. (2020). 'The legitimacy threshold revisited: How prior successes and failures spill over to other endeavors on kickstarter'. *Academy of Management Journal*, **63**, 472–502.
Stanko, M. A. and Henard, D. H. (2017). 'Toward a better understanding of crowdfunding, openness and the consequences for innovation'. *Research Policy*, **46**, 784–98.

Tajedin, H., Madhok, A. and Keyhani, M. (2019). 'A theory of digital firm-designed markets: Defying knowledge constraints with crowds and marketplaces'. *Strategy Science*, **4**, 323–42.
Thomas, L. D. W., Autio, E. and Gann, D. M. (2014). 'Architectural leverage: Putting platforms in context'. *Academy of Management Perspectives*, **28**, 198–219.
Tiwana, A. (2013). *Platform Ecosystems: Aligning Architecture, Governance, and Strategy*. Waltham: Morgan Kaufmann.
Tiwana, A., Konsynski, B. and Bush, A. A. (2010). 'Research commentary – Platform evolution: Coevolution of platform architecture, governance, and environmental dynamics'. *Information Systems Research*, **21**, 675–87.
Van Maanen, J., Sørensen, J. B. and Mitchell, T. R. (2007). 'Introduction to special topic forum: The interplay between theory and method'. *Academy of Management Review*, **32**, 1145–54.
Viotto da Cruz, J. (2018). 'Beyond financing: Crowdfunding as an informational mechanism'. *Journal of Business Venturing*, **33**, 371–93.
Wareham, J., Fox, P. B. and Cano Giner, J. L. (2014). 'Technology ecosystem governance'. *Organization Science*, **25**, 1195–215.
Weyl, E. G. (2010). 'A price theory of multi-sided platforms'. *The American Economic Review*, **100**, 1642–72.
White, L., Lockett, A., Currie, G. and Hayton, J. (2021). 'Hybrid context, management practices and organizational performance: A configurational approach'. *Journal of Management Studies*, **58**, 718–748. https://doi.org/10.1111/joms.12609
Zenger, T. R., Felin, T. and Bigelow, L. (2011). 'Theories of the firm–market boundary'. *Academy of Management Annals*, **5**, 89–133.
Zittrain, J. L. (2005). 'The generative internet'. *Harvard Law Review*, **7**, 1975–2040.