Understanding Ecosystems and Their Implications for Innovation Studies

# **Abstract**

The notion of ‘ecosystems’ provides an attractive metaphor to describe a range of interactions and inter-linkages between multiple organizations. First introduced in practitioner literature in the mid-1990s (Moore, 1993, 1996), this metaphor has been increasingly adopted also in research journals such as the Strategic Management Journal (Adner & Kapoor, 2010; Gulati, Puranam, & Tushman, 2012; Pierce, 2009; Teece, 2007). It has recently been argued that the focus of marketing and strategy must be on shaping the ecosystem in which the firm resides (Singer, 2006), and firms should increasingly move away from industry-focused strategic planning towards strategizing within and around ecosystems (Iansiti & Levien, 2004b). Arguably, the attractiveness of this rather loosely defined and versatile metaphor rests on its ability to evoke and highlight interdependencies between organizations and to provide a fresh way to think about specialization, co-evolution, and co-creation of value (Adner & Kapoor, 2010; Frels, Shervani, & Srivastava, 2003).

The emergence of ecosystems as in interesting metaphore raises an important question about its consensus in research community: Do notions of ecosystem add insight beyond existing constructs of broadly similar content, such as value chains and supply networks, or are we dealing simply with yet another convenient catchphrase that allows management consultants substitute substance for impression? An exploratory review of the literature would certainly suggest ample reason to be skeptical. Most of the uses of the term ecosystem are found in practitioner literature, with only few treatments in academic journals; definitions proliferate and are often difficult to reconcile; and the term has been used in a variety of contexts without much cross- fertilization between domains and levels of analysis. As we will seek to demonstrate in this study, however, proliferation does not necessarily mean absence of progress. While the field is certainly fragmented, pockets of advances exist, and taken together, the literature does appear to provide insight into the management of innovation in evolving networks of interconnected actors organized around a focal firm or platform. Reviewing the proliferating ecosystem literature and extracting insight for management of innovation is what we seek in this research piece. We aim to show that the ecosystem construct does have at least some research consensus and we seek to illustrate what that consensus might look like.

# **Keywords**

Ecosystems, complementary assets, platforms, value creation, network embeddedness, network management.

# **1)- Introduction**

The term ‘ecosystem’ has been applied in a wide variety of contexts outside its original application in biological systems. In management research, the term ‘ecosystem’ has been usually used to refer to a network of interconnected organizations that are linked to or operate around a focal firm or a platform (Iansiti & Levien, 2004a, b; Moore, 1993, 1996; Teece, 2007). The difference with other network constructs in management research is that this network covers both production side and use side participants, including complementary asset providers and customers. According to Moore (1993) an innovation eco-system is defines as: *a network of interconnected organizations, organized around a focal firm or a platform, and incorporating both production and use side participants, and focusing on the development of new value through constant innovation*.

This definition incorporates a central focus around which production and use side participants are organized. Such a central focus could be either a focal firm in the locality (Adner & Kapoor, 2010; Teece, 2007), a central hub firm (Iansiti & Levien, 2004a, b; Moore, 1993, 1996), or a platform (Cusumano & Gawer, 2002; Gawer & Cusumano, 2002). The explicit inclusion of use side participants differentiates the ecosystem construct from other networks in management literature, such as clusters, innovation networks, industry networks, which are focused on the production side, and user networks, which focus on the use side. On the other hand, ecosystems research can be considered part of a wider and heterogeneous body of network literature in management research (Steen, John, et al, 2018). In this literature, the inclusion of use side participants is not a unique characteristic of ecosystems, as use-side participants are also included in strategic networks (Gulati, Nohria, & Zaheer, 2000; Jarillo, 1988), business networks (Anderson, Hakansson, & Johanson, 1994; Möller & Svahn, 2006), value nets (Nalebuff & Brandenburger, 1996), value networks (Christensen & Rosenbloom, 1995; Stabell & Fjeldstad, 1998) and value constellations (Normann & Ramirez, 1993). This broad body of related work draws on the network as separate mode of organization as compared to the market and hierarchy (Thorelli, 1986), the social embeddedness of economic action (Granovetter, 1985; Uzzi, 1997), the idea of the “network organization” and “virtual organization” (Miles & Snow, 1986), value chain, market structure and value appropriation considerations (Porter, 1980, 1985; Teece, 1986), the resource-based, core competence and relational views (Barney, 1991; Dyer & Singh, 1998; Prahalad & Hamel, 1990), and differing sources of innovation (Von Hippel, 1988). These theoretical foundations have provided a fertile soil for the ecosystems thinking to develop.

Although seldom explicitly defined, the applications of the ecosystem construct exhibit distinctive characteristics that help set it apart from related constructs. Above we noted that this is the only construct to explicitly conceptually cover both upstream (production side) and downstream (user side) activities. This whole system view simplifies the original meaning of the term. The ecosystem construct is distinguished from value chain and supply chain constructs by its non-linear aspect, as it includes both vertical and horizontal relationships between actors. This construct is also distinguished from value creation –oriented constructs such as value networks and value constellations by its focus on value appropriation and use. A distinctive aspect associated with this construct relates its focus on the evolution of networks of interconnected actors towards new states, rather than emphasizing optimization of the output potential of the current network configuration.

This paper is constructed as follows. We first review ecosystem literature, from two perspectives. First, drawing on ecosystem research as carried out in different empirical contexts, we summarize insights with regard to ecosystem boundaries, structure, and coordination. Second, we review three theoretical perspectives that can be applied to ecosystem research – mainly, the value creation perspective, the network embeddedness perspective, and the network management perspective. Drawing on these reviews, we then elaborate on the application of the ecosystem concept in innovation strategy analysis, design, and implementation. We labeled three main streams in which ecosystem literature has evolved in recent research as value creation, network embeddedness, and network management streams. These are summarized in Table 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Research Stream** | **Ecosystem domain** | **Value creation** | **Network Embeddedness** | **Network management** |
| Construct Variants | Ecosystem, innovation ecosystem, business ecosystem. | Value network; value constellation | Strategic network; business network; innovation network | Business network; value net |
| Description | Dynamic and purposive networks of production and consumption side participants. | Non-linear value creating system | Long term, purposeful arrangements among distinct but related organizations | Intentional interorganizational structures designed deliberately for specific purposes |
| Core Discipline | General management | General Management; Marketing | General Management; Marketing | Marketing |
| Key Concepts | Value co-creation; participant symbiosis; ecosystem coordination | Value co-creation; interdependence | Co-specialization; complementarity | Network coordination; |
| Key Influences | Chandler (1962); Williamson (1975); Porter (1980; 1985); Wernerfelt (1984); Teece (1986); Brandenburger & Nalebuff (1996); Gawer & Cusumano (2002) | Porter (1980; 1985); Katz & Shapiro (1985); Normann (1993); Christensen (1997); Chesbrough & Rosenbloom (2002) | Williamson (1975); Granovetter (1985); Thorelli (1986); Von Hippel (1988); Womack (1990) | Anderson (1994); Uzzi (1997); Dyer & Singh (1998); Achrol (1999); Zollo (2002); Gulati et al (2000); Hakansson & Ford (2002) |
| Empirical Context | Information and internet technologies; telecommunications; manufacturing | Information technologies; telecommunications | Cross industry; manufacturing; information technologies | Cross industry; manufacturing |
| Main Journals | Harvard Business Review; Sloan Management Review; Strategic Management Review. | Telecommunications Policy; Long Range Planning; Journal of Academy of Marketing Science | Industrial Marketing Management; Sloan Management Review; Strategic Management Journal | Industrial Marketing Management |
| Main contribution | Moore (1993); Iansiti & Levien (2004); Teece (2007); Adner & Kapoor (2010) | Normann & Ramirez (1993); Christensen & Rosenbloom (1995); Stabell & Fjeldstad (1998) | Jarillo (1988); Anderson et al (1994); Gulati et al (2000); Afuah (2000) | Ritter et al (2004); Moller et al (2005); Moller & Svahn (2006) |

**TABLE 1 – Overview of Ecosystem and Related Research**

# **2)- Literature Review**

## ***2.a) Ecosystem Boundaries, Structure and Dynamics***

The diversity in ecosystem concepts and definitions reflects the diversity of contexts in which the concept has been applied. A sampling of studies across different contexts provides insight into the nature of innovation ecosystems. Three sets of insights are discussed here – relating to ecosystem boundaries, structure, and dynamics arising from relationships and interactions between ecosystem participants.

Since the introduction of the concept to management literature, there have been quite a few attempts to discuss innovation ecosystems in a substantive manner. Moore (1993) first used the term to describe a set of producers and users around a focal organization that contributed to its performance. Moore’s insight was that a given company is not viewed as a member of a given industry, but rather, as part of a ‘business ecosystem’. Moore made the point that interactions between firms and collective value creation processes are often much more complex than what received strategy frameworks drawing on an industrial organization perspective had implied (Porter, 1980, 1985). This insight was similar to the notion of value network by Christensen & Rosenbloom (1995), which considered the value network as the context, or the nested commercial system, within which a firm competes and solves customers’ problems. An ecosystem concept is broader, as it covers the community of organizations, institutions, and individuals that impact the fate of the focal firm and its customers and supplies, including complementors, suppliers, regulatory authorities, standard- setting bodies, the judiciary, and educational and research institutions (Teece, 2007).

Moving beyond this basic contextual view, ecosystems have also been seen as dynamic and purposive networks in which participants co-create value (Adner & Kapoor, 2010; Lusch, Vargo, & Tanniru, 2010). In this perspective, ecosystem participants co-evolve capabilities around a shared set of technologies and cooperate and compete to support new products, satisfy customer needs, and eventually incorporate the next round of innovation (Moore, 1993, 1996). In this sense, ecosystems are collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution, and which allow firms to create value that no single firm could do alone (Adner, 2006; Moore, 1996). Ecosystems hence extend the concept of a value chain to that of a system that includes any organization that contributes to the shared offering in some way (Iansiti & Levien, 2004a, b). This means that an ecosystem may include participants from outside the traditional value chain of suppliers and distributors, such as outsourcing companies, financial institutions, technology providers, competitors, customers, and regulatory and coordinating bodies.

The variety of ecosystem participants gives rise to difficulty in defining the boundaries of ecosystems. Boundary definition is complex as boundaries in ecosystem contexts are usually considered to be fairly open and permeable (Gulati et al., 2012). This difficulty is reflected in the different attempts to operationalize ecosystem boundaries. As an example, in their value-based model, Adner & Kapoor (2010) defined an innovation ecosystem to consist of only those participants (suppliers, complementors, customers) that were only one network link away from the focal firm or customer. Other operationalizations are not as clear-cut. Iansiti & Levien (2004b) emphasized participant identification with the ecosystem community and argued that ecosystem boundaries are focal firm specific, drawn through the identification of ecosystem participants with the wider ecosystem community. Santos & Eisenhardt (2005) pointed out that ecosystems have broader boundaries than those implied by market efficiency. They specifically highlighted power and the specialization of organizational competencies as defining features of ecosystem boundaries. Although different boundary definitions may be applicable to different purposes and perspectives, it is clear that ecosystem boundaries only rarely overlap with traditional industry boundaries, as defined by a given set of products and their producers. The defining underling element of innovation ecosystems is not a given product, but a rather, a coherent set of inter-related technologies and associated organizational competencies that glue a variety of participants together to co-produce a set of offerings for different user groups and uses. Instead of thinking about ecosystems as an industry, it is more useful to think about ecosystems as an evolving community that specializes in the development, discovery, delivery, and deployment of evolving applications that exploit a shared set of complementary technologies and skills.

Thus, a defining characteristic of innovation ecosystems is the ability to adapt and evolve (Basole, 2009). A healthy ecosystem is productive, in that it consistently transforms technology and other inputs to innovation into lower costs and new markets, and robust, i.e., capable of surviving disruptions such as unforeseen technological change and able to create niches to increase meaningful diversity (Iansiti & Levien, 2004a). Relationships among ecosystem participants are often symbiotic, and members co-evolve with the system (Iansiti & Levien, 2004a; Li, 2009; Moore, 1996). Each member of an innovation ecosystem ultimately shares in the fate of the system as whole (Li, 2009). To the extent that these characteristics are met, a given participant can be thought of residing within the boundaries of a given ecosystem and not outside it.

The question of who belongs to an ecosystem and who doesn’t evoke the natural corollary question of ecosystem structure. The multiplicity of participant types, roles, and interdependencies implies that challenges are not equally distributed across participants (Adner & Kapoor, 2010). The interdependence among ecosystem participants also raises the question of how ecosystems are coordinated and managed. In many contexts, a hub firm or firms exist that coordinate services to the system (Cusumano & Gawer, 2002; Iansiti & Levien, 2004a; Li, 2009; Pierce, 2009) . Such firms may control the technological architecture or the brand that drives value in the ecosystem, and coordination may be based on architectural control, for example, or perhaps on the regulation of access to a given shared platform, as in the case of eBay or Android, for example. Indeed, a substantive subset of the literature proposes ‘platforms’ as the coordinating artifact that hub firm uses, or the services, tools and technologies that other members of the ecosystem can use to enhance their own performance (Cusumano & Gawer, 2002; Iansiti & Levien, 2004a, b; Li, 2009).

Not all of the literature proposes the existence of a central coordinating firm, with much of the network embeddedness literature focusing on a focal firm that does not necessarily have a coordinating role. In that stream, the focal firm is not required for coordination purposes but instead is necessary for empirical and methodological reasons, as the research is more interested in the individual dyads and ties than the actual roles of the participants. In addition, empirical ecosystem research has identified network roles other than the hub firm. For instance, in his study of the mobile technology ecosystem, Basole (2009) found that there was no central firm that played a coordinating role. Similarly, in their structural analysis of the software sector, in addition to identifying coordinating hub organizations, Iyer, et al (2006) also identified broker organizations that acted as liaisons, representatives, or gatekeepers, and bridging organizations. Thus, although there is empirical verification of hub firms in ecosystem contexts, other network roles are also present. Despite these reservations on the role of a coordinating firm in the network structure stream, and indications of other roles in the network from the ecosystem stream, the majority of the ecosystem and related streams explicitly discuss a central firm that coordinates the ecosystem.

Whatever the coordination device, such devices are central to the health and stability of an ecosystem as they drive the collective performance of a network by enabling and facilitating value creation and sharing (Evans, Hagiu, & Schmalensee, 2006; Gawer & Cusumano, 2002; Iansiti & Levien, 2004a). Network research suggests that hubs naturally emerge in networks, regardless of the quality of the networked system, its participants, or the specific nature of their connections (Barabási, 2002; Barabási & Albert, 1999; Cohen, 2002; Newman, 2001). For instance, for digital services it was found that while the number of digital services grew in a linear fashion, the distribution of complementors to hub firms followed a power law, implying a small number of hub firms provided for a majority of complementors (Weiss & Gangadharan, 2010). The control of the coordination device, however, may reside with a single company, a collection of firms, a consortium, or a not-for- profit organization (Chesbrough & Appleyard, 2007). This underlying architecture may be a ‘platform’, but it does not have to be (Cusumano & Gawer, 2002; Iansiti & Levien, 2004a, b; Jacobides, Knudsen, & Augier, 2006; Teece, 2007). Although a successful platform typically has an ecosystem surrounding it, an ecosystem does not necessarily have a platform at its core.

In addition to formal and ownership-based control devices, there are also informal coordination mechanisms that influence the evolution of innovation ecosystems. These include social and behavioural coordination devices embedded in ecosystem relations, such as trust, tact, professionalism, openness, transparency and complementarity, all of which are seen as crucial in the development of open-source ecosystem relationships (Agerfalk & Fitzgerald, 2008). Key enablers of trust building within ecosystem environments include complementarity of obligations over the product lifecycle, differing perceptions of obligation fulfillment, and balance between value creation and community values. In the context of software firms, Iyer, Lee, & Venkatraman (2006) found that the software sector operates as a small world ecosystem, which continued to be small worlds during the emergence of the Internet and despite technological changes. Because of well-established informal control devices, the ecosystem was efficient at transferring information and diffusing innovative advances and resources through the ecosystem. Thus, informal mechanisms facilitate innovation by promoting information disclosure and sharing, and therefore, innovation through knowledge combination, whereas formal mechanisms are instrumental in preventing dissipation of effort and in channeling attention to promising areas of development.

Some researchers have taken an institutional approach in understanding the coordination and evolution of innovation ecosystems (Thomas & Autio, 2012). Innovation ecosystems can be portrayed as organizational fields, or “those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products“ (DiMaggio & Powell, 1983:148). As a theoretical construct, an innovation ecosystem is analogous to an organizational field in that it has its own institutional actors, logics, and governance structures (Scott, 2007). The key difference between an organizational field and an ecosystem is that instead of covering participants that produce a similar services or products (or what could be considered a single industry), an ecosystem represents a cross- industry network of producers of different goods and services that nevertheless combine to support coherent value offerings (Iansiti & Levien, 2004a, b; Moore, 1996). The introduction of institutional theory into innovation ecosystem analysis provides a useful theoretical lens for understanding the organizing principles and behavioural rules and norms that support and regulate informal coordination and coherence in the allocation of effort.

## ***2.b)- Ecosystem Behavioural Logics***

Having reviewed received insights into the boundaries, structure, and governance mechanisms of innovation ecosystems, we next turn to the theoretical lenses that can be applied to understanding their behavioural logics. Our review of the literature uncovered three thematic streams, with broadly coherent and distinctive theoretical underpinnings, that enable the consideration of various aspects of operation of and within innovation ecosystems. In Table 2 we provide some examples of empirical research for each stream.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Stream** | **Study** | **Context** | **Method** | **Industry** | **Results** |
| Ecosystem | Iyer, Lee & Venkatraman (2006) | Information Technologies | Quantitative | Packaged software industry | The software sector operates as a small world ecosystem, the structure of which continued during the emergence of the Internet and despite technological changes. This indicates that the network is very efficient at moving information, innovations and resources through the ecosystem. |
|  | Adner & Kapoor (2010) | Information Technologies | Quantitative | Semi-conductor lithography equipment | Challenges in the external ecosystem can either enhance or erode a firm's competitive advantage from technology leadership. Specifically, the advantage from technology increases from component challenges, and decreases from complement challenges. |
| Value Creation | Christensen & Rosenbloom (1995) | Information Technologies | Case Study | Disk drive industry | In addition to the characteristics or magnitude of the technological change relative to capabilities of the incumbent, and the managerial processes and organizational dynamics through which entrant firms respond, there is a third factor, the value network, which affects whether incumbent or entrant firms will most successfully innovate. |
|  | Huemer (2006) | Logistics | Case Study | Logistics service providers | The value network logic provides a fruitful alternative to the value chain, and reveals a number of complexities in supply relationships, such as differences in value creation logic, additional structural dimensions, and multiple interdependencies. |
| Network Embeddedness | Afuah (2000) | Information Technologies | Quantitative | RISC workstation manufacturers | A firm's performance decreases after a technological change with the extent to which the technological change renders co-opetitors capabilities obsolete. |
|  | Rabinovich, Knemeyer & Mayer (2007) | Information Technologies | Quantitative | Ecommerce sites | Low levels of asset specificity and uncertainty drive internet commerce firms to establish these relationships, as well as the fact that these relationships offer access to networks that bundle many complementary services. |
| Network Management | Hughes, Ireland & Morgan (2007) | Cross Industry | Quantitative | Incubators in the UK | The network in incubators only dictates opportunities for value creation, and it is firm behavior that dictates the extent to which these opportunities can be realized. |
| This is missing | Oberg, Hennenberg & Mouzas (2007) | Cross Industry | Case Study | Truck manufacturer, electronic billing system integrator; IT sales | Following a merger or acquisition managers need to adapt their previous network pictures in a radical way; however not all managers adjust their network pictures and networking activities to adjust to new reality. |

**TABLE 2 – Examples of Empirical Research**

The value creation theme focuses on value creation processes within innovation ecosystem contexts. It builds upon and extends industrial organization frameworks of strategic management, notably those addressing industry structure, industry value chains, and value appropriation in industry contexts (Porter, 1980, 1985; Teece, 1986), by emphasizing the non-linear, iterative, and non- sequential nature of value creation and appropriation processes in industry networks. This stream contributes to ecosystem research by explicating the theoretical logic of value creation and appropriation in ecosystem contexts, as well as the mechanisms that drive value in network contexts, such as network externalities and complementary innovation. The network embeddedness stream emphasizes the structural and relational aspects of networks, and considers prerequisites and constraints of operation within innovation ecosystems. This stream also extends the theoretical base of ecosystem research by introducing notions of social theory, trust and legitimacy at the dyad level such as that proposed in virtual organizations (Miles & Snow, 1986). The network management stream emphasizes the management strategies and tactics for coordinating and managing within network contexts (Miles & Snow, 1986; Möller, Rajala, & Svahn, 2005). This stream extends the ecosystem construct by explicitly including considerations of the hub firm and differing approaches of network management. Together these three additional related streams deepen the theoretical base of the ecosystem construct and in doing so, make the construct more applicable for empirical research.

# **3)- Research Streams in Ecosystem literature**

XXX

## ***3.a)- Value Creation Stream***

The value creation thematic stream constitutes somewhat of a ‘hodgepodge’ theme. Value creation in networks has been considered from a number of perspectives, with slightly different theoretical framings (Lee, Lim, & Soriano, 2009). The general thrust, however, has centered around the idea of adding horizontal linkages between participants of value networks in contrast to the predominantly vertical and sequential orientation of Porter’s (1985) infamous value chain model.

In this thematic stream, an early approach focused on the notion of ‘value constellations’, as coined by Normann & Ramirez (1993).They observed that value is not built through sequential processes, as suggested by Porter (1985), but rather, as the result of a complicated set of economic transactions and institutional arrangements between suppliers, customers, specialized service providers, and other complementors. This observation of the non-sequential and systemic nature of value creation was presented as the authors as a new logic of value creation. In particular, Normann & Ramirez (1993) argued that the goal of business is to mobilize customers to co-create value; that the most attractive offerings involve networks of customers, suppliers, allies, and business partners in new combinations; and that the only true source of competitive advantage is the ability to conceive of an entire value-creating system and make it work. Such themes have been echoed in subsequent work on value creation in networks. For instance, Normann (2001) noted that innovative value constellations "identify economic actors and link them together in new patterns which allow the creation of new businesses that did not exist previously, or change the way certain types of value are created” (p 107). This value-creating logic has been further emphasized as a non-linear value-creating system that consists of suppliers, partners, allies, and customers, and where an organization’s goal is to “innovate customers” through changing the way value is co-created (Michel, Brown, & Gallan, 2008). Echoing meanings attached to the innovation ecosystem construct, value constellations have also been seen as a particular type of inter-organizational network established to create value when any single company is unable to launch the product on its own and where each actor within the constellation can capture a sufficient portion of the overall value to justify its participation (Lin, Wang, & Yu, 2010). The value constellation construct has become integral to many service- dominated business logics, as emphasized by Michel, Vargo & Lusch (2008).

Similarly to work on value constellations, Stabell & Fjeldstad (1998) asked how the analytical concepts provided by value chain theory can be extended beyond traditional manufacturing contexts, thereby highlighting limitations of the hitherto dominant value chain theory by Porter (1985). In addition to the value chain, Stabell and Fjeldstad identified the ‘value shop’ and the ‘value network’ as alternative conceptual frameworks within which to study value creation. A firm in a value network creates value through the facilitation of network relationships with customers using a mediating technology (Thompson, 1967). In this conception, value is created through a managed meditation service, where value is driven by positive demand-side externalities and by the service opportunity and service delivery capacity. In value networks, competitive advantage results from scale building, capacity utilization, and linkages between participants and learning (Stabell & Fjeldstad, 1998). The value network concept has also been applied usefully to supply chain contexts, where the value network logics reveal a number of complexities such as differences in value creation logic across value chains, additional structural dimensions, and multiple interdependencies (Huemer, 2006). Thus, the value network construct by Stabell & Fjeldstad offers as alternative view of understanding value creation in mediated network contexts.

Another approach to understanding value creation in network contexts has been to integrate value chain and network concepts. In an early approach, Weiner, Nohria and Hickeman (1997) proposed value networks to emerge where value chain assets are disaggregated and no single organization controls them all. In this conception, the focal company connects and exploits the strengths of each complementary value provider, by coordinating production and delivery across companies to deliver value to a specific customer segment. The value network thus enables a coalition of players to exert greater market power and extend the scope of the markets they address and offerings they produce. A more recent approach considers the value network as a series of intertwined value chains where some nodes are simultaneously involved in more than one value chain (Li & Whalley, 2002). In this conception, a multitude of market entry points exist where a diverse range of companies enter the market through different routes, and the exit point - where the company interacts with its chosen end customers – may differ significantly according to the business model of the different players (Li & Whalley, 2002). Similarly, Funk (2009) considered value networks as connecting multiple buyers and sellers at a single node, where the node can be part of a value chain or of a larger value network, integrating value constellations and value networks (Weiner et al., 1997). For Funk, a value network implies increased complexity of firm inter-relationships, network externalities, standards, critical mass, multi-sided markets, and policy considerations within the value network (Funk, 2009). In these value networks, each participant shares in the success or failure of the network (Pagani & Fine, 2008).

Another related concept for the study of value creating systems is that of the ‘value net’, (Parolini, 1999). The value net is a dynamic, collaborative network which combines each participant’s core competences (Bovet & Martha, 2000). A value net is formed around customers and it captures the customers’ choices in real time in an effort to satisfy actual demand. Value nets are fluid and flexible, comprising a group of collaborators that unite to exploit a specific opportunity – and once the opportunity is met, the net often disbands. In the concept's purest form, each company that links up with others to create a virtual corporation contributes only what it regards as its core competencies (Christopher & Gaudenzi, 2009).

Summarizing, this theme has explored various aspects of value creation dynamics in innovation ecosystems. This line of research was prompted as a reaction to the linear and sequential conception of value creation processes in the value chain theory Porter (1985). In contrast with this perspective, the value creation theme has emphasized co-creation of value, the importance of collaboration between network participants, and value creation through the combination of each participant’s specialized capabilities and core competences within the value network.

## ***3.b)-Network Embeddedness Stream***

The network embeddedness theme emphasizes the structural and relational aspects of the network in which ecosystem participants are embedded and considers the prerequisites and constraints of operation within innovation ecosystems from the perspective of the participating organizations (i.e., not necessarily that of hub firms). This thematic stream seeks to understand how individual ecosystem participants can best take advantage of the innovation ecosystem that surrounds them. As ecosystem relationships are characterized by intense interactions between complementary participants, much of the effort has gone into understanding how ecosystem participants can build relational assets into their ecosystem relationships so as to facilitate smooth transactions and collaborations (Dyer & Nobeoka, 2000); establish favourable initial network positions (Hallen & Eisenhardt, 2012; Ozcan & Eisenhardt, 2009) encourage knowledge sharing for innovation (Yli-Renko, Autio, & Sapienza, 2001); exploit favorable structural positions for performance (Wincent, Anokhin, Örtqvist, & Autio, 2010a); promote movement to desired directions (Wincent, Örtqvist, Eriksson, & Autio, 2010b); and to generate trust and norms and rules that to facilitate the efficient operation of the network.

An early framing of the challenges of operating as part of a wider network was introduced by the concept of “strategic networks”, defined as long term, purposeful arrangements among interconnected firms that seek to build competitive advantage relative to competitors outside the network (Jarillo, 1988). Jarillo argued that strategic networks exhibit some of the properties of both markets and hierarchies, as the activities necessary for the production of a given good or service can be carried out either by an integrated firm or by a network of firms. Within strategic networks, participating firms farm out some activities while specializing more fully on those in which it has an opportunity to build comparative advantage. This combination of outsourcing and specialization creates interdependency among the network participants, which grows stronger as a function of mutual co-specialization. In this approach, value is either appropriated fairly if sufficient trust is built into the relationships between network participants, or on the basis of power and control of critical assets if power relations are asymmetric and the scope of abuse is not mitigated by enlightened self- interest (Adner & Kapoor, 2010; Casciaro & Piskorski, 2005; Jarillo, 1988). Thus for the participating firm, having a good understanding of the activities in which they have a comparative advantage, combined with a realistic understanding of the potential dangers inherent in co-dependent relationships is key to successful operation in an innovation ecosystem.

Balancing the benefits of specialization with the hazards of dependence necessitates the building of relational assets that mitigate opportunism. Building upon the notion of strategic networks, Gulati, Nohria and Zaheer (2000) took a broader relational view (Dyer & Singh, 1998) to understand participant network embeddedness, arguing that the constituting relationships are enduring and are of strategic significance for the firms entering them. As such, these relationships can be strategic alliances, joint ventures, long-term buyer-supplier partnerships, and so on, essentially encompassing the firm’s set of relationships, both horizontal and vertical, be they with suppliers, customers, competitors or other entities, including relationships across industries and countries. This network of relationships acts as a source of both opportunities and constraints to the participating firm. In particular, network embeddedness can be a source of opportunity, as it potentially provides a firm with access to information, resources, markets, and technologies such as contractual power, increased innovation generation, improved technological transfer opportunities, and improved entry opportunities (Nosella & Petroni, 2007). In addition, it allows participating firms to achieve strategic objectives, such as sharing risks and outsourcing value chain stages and organizational functions, enabling learning, scale and scope economies (Gulati et al., 2000; Rabinovich, Knemeyer, & Mayer, 2007). Learning in these contexts can usefully be regarded as occurring at the inter-organizational level, as well as between groups of organizations (Knight, 2002). In contrast, the network embeddedness of a participating firm can also be a constraint as it may lock firms into unproductive relationships or preclude partnering with other viable firms (Gulati et al., 2000). Similarly, being embedded in a network does not necessarily lead to value creation, only to opportunities to do so, and it is how the participating firm behaves and pursues opportunities that leads to their success (Hughes, Ireland, & Morgan, 2007). In addition, firms need to balance between broadening their number of relationships and maintaining those existing relationships, as these have an interlinked effect on firm performance (Wincent et al., 2010a).

Network participants can also move beyond dyad-specific relational assets to promote ecosystem-wide norms that reinforce predictability in mutual exchanges and mitigate opportunism (Bosse, Phillips, & Harrison, 2009; Wincent et al., 2010a). Strategic networks pursue shared goals through collective efforts by multiple participants, all of whom also have their own strategic interests that do not always align with those of the wider network (Gulati et al., 2000). Strategic networks and innovation ecosystems therefore face distinctive governance challenges. An important challenge is created by the lack of immediate link between individual members’ efforts and the collective benefits (Winkler, 2006). To materialize the benefits of the strategic network, participants need to commit resources towards shared goals. Because reciprocation is not immediate, however, opportunities for free-riding arise (Rosenfeld, 1996; Vanhaverbeke, Gilsing, Beerkens, & Duysters, 2009). Reciprocation is not even always direct, but rather, a firm’s commitments may be reciprocated by a third party within the ecosystem. The delay and often indirect nature between resource commitments and reciprocation creates an incentive for free-riding and complicates the evaluation of partners’ goodwill (Human & Provan, 1997; Powell, Koput, & Smith-Doerr, 1996). To overcome this governance challenge, firms participating in strategic networks need to establish and reinforce generalized reciprocity that is designed to mitigate risks of opportunism and free-riding (Bercovitz, Jap, & Nickerson, 2006; Das & Teng, 2002; Das & Teng, 2003). Without such norms, there is a significant risk that one’s efforts are not reciprocated. Strong shared norms, that encourage reciprocity and increase the social cost of free-riding, can operate as a strong informal governance mechanism that reduces opportunism and promotes collaborative behavior (Bercovitz et al., 2006). Therefore, generalized reciprocity norms provide a particularly potent alternative to contractual governance mechanisms especially in multi-stakeholder collaborations involving shared development efforts, such as those often prevailing in innovation ecosystems (Wincent et al., 2010a).

Network change can alter the balance of network relationships and thus create challenges of adaptation (Halinen, Salmi, & Havila, 1999). Change events in one part of the dyad can have effects at the network level, and similarly network changes can reflect on the balance of each dyad. In order to understand sense-making by embedded participants during eras of network change, Oberg, Henneberg & Mouzas (2007) proposed a cognitive approach, ‘picturing’, where the position of the participant within the network is visualized by integrating perceptions of customers' needs and developments. Change efforts can be understood as a negotiated process where overlapping network representations are re-negotiated to fit multiple actor constituencies (Kragh & Andersen, 2009). The cognitive framing of networks has been further developed to include ‘network insight’, which is not only includes the pictures held by individual manager but also grounded in the practice of inter-firm exchange (Mouzas, Henneberg, & Naudé, 2008).

Summarizing, this stream emphasizes the structural and relational view of networks, and introduces wider marketing considerations into ecosystem research. This stream extends the theoretical base of ecosystem research by introducing notions of social theory, trust, and legitimacy at the dyad level.

## ***3.c)-Network Management Stream***

The network management theme considers how organizations can proactively manage the innovation ecosystem, or the ‘business network’(Möller & Svahn, 2003; Ritter, Wilkinson, & Johnston, 2004). This stream differs from the network embeddedness theme in that whereas that theme seeks to understand how firms can best adapt to and take advantage of innovation ecosystems, the network management theme considers how firms can manage innovation ecosystems themselves and influence their operation. This stream builds on early observations that strategic networks can be managed (e.g., Dyer & Singh, 1998; Jarillo, 1988). In much of this thematic stream, the focus has been on the ‘business network’, the ‘value net’ or the ‘strategic nets’ (e.g., Nalebuff & Brandenburger, 1996; Ritter et al., 2004). These are inter-organizational structures designed set up deliberately for specific purposes and consisting of coalitions of autonomous but interdependent firms that are willing to coordinate some of their actions and sometimes even to submit part of their activities and decision domains to centralized control in order to achieve benefits that are greater than any single member of the net can create independently (Möller & Svahn, 2006). Others have extended the reach to include alliance partners (Afuah, 2000, 2004) and followers, imitators, universities, professional bodies and other institutions (Kang & Afuah, 2010; Möller & Svahn, 2009).

The earliest consideration of network management is that which considers ‘co-opetition’, a term introduced by Nalebuff & Brandenburger (1996). Here the focal firm is able to utilize games to coordinate and appropriate value from its network. This stream refers to the ‘value net’ as the network of customers, suppliers, competitors, and complementors. Key to understanding this stream of research is the relationship between the participants: customers and suppliers play symmetric roles and competitors and complementors play mirror-image roles (Nalebuff & Brandenburger, 1996). Hence Nalebuff & Brandenburger (1996) developed a game theoretic approach that focused on balancing competitive and cooperative challenges. The classic ‘co-opetitive’ strategies include imitation, combination, shut out, entry and holdup. Such game strategies enable firms to better position themselves to capture rent from innovations and enable further innovation (Kang & Afuah, 2010). This game theoretic approach has also been extended to include institutional interactions between industry and government, as efforts to influence government are often business competition in disguise (Watkins, 2003). This extension includes two further types games where the government can act as rule makers and as referees, value-net games and public interest games (Watkins, 2003).

Much of the work in the network management theme builds on the observation by Möller & Svahn (2003), who argued that the management of a network requires specific organizational capabilities. Building on this observation, Ritter, Wilkinson, & Johnston (2004) distinguished between the ‘managing in’ of relationship such as the coping within a certain network situation, versus the ‘managing of’ relationships such as leading, determining, and organizing. Möller, Rajala, & Svahn (2005) distinguished between different levels of network operation and argued that management challenges differ for different levels. They suggested that network *visioning* and *orchestration* are most relevant when the focus is on the network as a whole. Network *operation* and *coordination* was relevant at the level of the hub firm, when it managed an existing network. Tie portfolio management was relevant at the relationship portfolio level; and relationship management dominated at the level of individual dyads. They further identified three factors that acted as boundary conditions for the firm’s ability to manage its network. First, the hub firm needed to be able to influence and control network value activities and other network participants. Such control could be achieved through the various coordination mechanisms and devices discussed above in the ‘coordination’ section. Second, sufficient commonality had to exist between the goals of the network as a whole and those of its constituent participants. Third, the structure of the network had to be amenable for coordination – for example, hub-and-spoke configurations lend themselves more readily for coordination than do distributed networks with no centrally positioned firms. Finally, these authors distinguished between three types of business networks, according to their maturity (Möller & Rajala, 2007; Möller et al., 2005; Möller & Svahn, 2006). Current (mature) business nets had a stable, well-defined value system consisting of well-known and specified value activities, well-known actors, technologies, and business processes, all of which enhanced the manageability and coordination of the network. Business renewal nets had an established value system with incremental improvements consisting of well-known value systems and change through local and incremental modifications within the existing value system. Finally, emerging business nets had an emergent value system with radical changes such as frequent entry by new actors, radical transformation in pre-established activities, constant creation of new value activities, uncertainty around both value activities and actors, and radical system-wide change. Such characteristics radically reduced the manageability and coordination of the network. More recently, this framework has been developed to consider how network management capabilities can be utilized to influence the creation of new business fields. central influencing mechanisms are cognitive – e.g., control of sense-making and agenda construction, as these influence the cognitive frames by the participants (Möller, 2010; Möller & Svahn, 2009)., Research on ecosystem creation, however, still remains in its infancy.

An interesting new stream has emerged, exploring how entrepreneurial firms use behavioural strategies to create and shape innovation ecosystems (Hallen, 2008; Hallen & Eisenhardt, 2012; Ozcan & Eisenhardt, 2009; Zott & Huy, 2007). Ozcan & Eisenhardt (2009), for example, found that entrepreneurs, who had a strategic vision of their industry, were more likely to build high-performing alliance portfolios. In addition, they found that strategies to pre-emptively shape emerging industry structure with alliance relationships were likely to lead to better performance, whereas structurally constrained tie-building strategies were less likely to do so. Hallen and Eisenhardt (2012) found that entrepreneurs could establish advantageous positions in innovation ecosystems by employing different catalyzing strategies, such as casual dating and timing relationship activities around important milestones. Together, this emerging stream suggests that entrepreneurs can circumvent structural inertia in network creation by employing a range of relational, institutional, and coordination strategies, thereby establishing more advantageous initial network positions and promote wider lock-in around a given ecosystem configuration.

Summarizing, this stream has emphasized the management strategies and capabilities that enable firms to proactively manage their innovation ecosystems. The bulk of the work has focused on game strategies and strategic plays that firms can employ to manoeuver within ecosystems. Only recently have researchers started to consider whether and how firms could initiate and proactively shape innovation ecosystems to their own advantage. This work remains in its very early stages, however, and little is still known about the early stages of ecosystem development.

# **4)-Implications for Innovation studies**

Although a major body of research has explored innovation ecosystems and closely related concepts, only recently has the literature begun exploring implications for innovation management. As a result, too little is still known about how firms can proactively create, steer, and leverage innovation ecosystems for enhanced innovation performance. In this discussion, we offer our view of the most important gaps in the field, and also discuss emerging implications for practicing managers. The most important gaps are: insufficient understanding of value appropriation and ecosystem creation, and insufficient elaboration of practitioner implications for strategic management

Despite the importance of the logic of value for innovation ecosystems, the majority of the ecosystems literature to date has not explicitly considered value creation and appropriation. Although Adner & Kapoor (2010) empirically linked value creation and value capture within ecosystem contexts, this is perhaps the only paper to date to have done so. Given the importance of the value logic, and in particular the co-creation and appropriation of value, in the ecosystem construct, a more coherent and detailed formulation similar to the value creation logics of Doz and Hamel (1998) for alliance contexts will aid both academic and practitioner understanding. We propose that strategic management practitioners, when planning for value creation and value appropriation in innovation ecosystems should consider:

* **Control Mechanisms**. Which are the major control mechanisms that enable firms to influence ecosystem evolution and use as levers for value appropriation? Possible control mechanisms include:

o **Shared platforms** (Cusumano & Gawer, 2002): if the ecosystem has been formed around a focal platform (e.g., an operating system; hardware platform; or a cloud service), the control of such a platform usually constitutes a strong appropriation lever.o **Critical assets** (Teece, 1986; Teece, 1998): critical assets are resources that are important for ecosystem operation, yet in scarce supply. Scarcity combined with criticality ensures strong appropriation ability. Examples of such assets include the Intel microprocessor architecture; exclusive distribution channels; and, for example, scarce and hard-to-substitute raw materials.

o **Pre-emptive alliances** (Ozcan & Eisenhardt, 2009). Sometimes pre-emptive alliances can become a strong control mechanism, particularly if they pre-empt access to critical assets by competitors. In their research, Ozcan and Eisenhardt (2009) showed how early entrants into the mobile gaming industry were able to secure valuable alliances, thereby locking themselves into a long-term positional advantage.

* **Value Creation Dynamics**. How is value created and delivered within the ecosystem? How much of it is based on services, manufactured goods, or intangible assets? Are value processes sequential and distributed along value chains; or are they parallel and horizontally distributed? How much of the value is co-produced at the point of use, and how much of it is stored into transferable goods and services? An understanding of the value creation dynamics is crucial for successful positioning within the ecosystem, and therefore, for successful appropriation of value.
* **Control Migration**. As ecosystems evolve, it is likely that also the critical control mechanisms migrate elsewhere. If the firm fails to anticipate and proactively plan for ecosystem evolution, its position may be undermined by ecosystem developments. One classic example is provided by IBM’s failure to anticipate the primacy of the user interface as a critical control device in the PC ecosystem. A more recent example is provided by Nokia’s fall from grace, as it failed to anticipate the transformation of the mobile phone industry from a tightly controlled supply chain system towards a smartphone-dominated system, where applications developed by others constitute a major control lever.
* **Value Externalities**. An important aspect of value creation in innovation ecosystems is defined by the existence of value externalities – or direct and indirect network effects that boost the overall value produced by the ecosystem. If the innovation ecosystem provides incentives and structures for complementary innovation, this may help encourage a superior value creation dynamic – as shown, e.g., in the case of the Android ecosystem.

As noted above, little is known about the processes by which innovation ecosystems are created. At present, the processes of ecosystem creation have been considered variously from both lifecycle and teleological perspectives (Van De Ven & Poole, 1995). For instance, a lifecycle approach has been proposed for ecosystem (Moore, 1993), network structure (Larson, 1992), and network management perspectives (Möller & Svahn, 2009). The lifecycle approach considers ecosystem creation as a series of path dependent stages driven by a common underlying process. Conversely, in a teleological perspective, an end state is attained through a repetitive sequence of goal formulation, implementation, evaluation, and modification (Gawer & Cusumano, 2008). However, while the understanding of ecosystem *evolution* is quite substantial, less is known about the exercise of entrepreneurial agency in ecosystem *creation*. As noted above, an emerging stream of behavioural strategies has considered simultaneous and interlinked teleological and lifecycle processes (Hallen, 2008; Hallen & Eisenhardt, 2012). However this literature is considered, no model to date comprehensively considers how complementary markets themselves are initially created (with the exception of Santos & Eisenhardt (2009)), nor is there much systematic work exploring the underlying processes. We propose that a coherent understanding of ecosystem creation requires a multi-theoretic approach, as well as a careful consideration of three related architectures – the technological architecture, the activity architecture, and the value architecture (Thomas, Autio, & Gann, 2012):

* **Technological Architecture**, or the design principles of shared technological resources and platforms, will determine who will be able to connect to the innovation ecosystem and in which roles. Key design issues involve, for example, the modularity of the system; openness or closedness of key interfaces; questions of which design aspects to put into the open domain and which to keep closed; and so on. By modifying such aspects of the technological architecture, the platform owner will influence who will be able to connect to the platform (i.e., activity architecture) and what the resulting value dynamic will be (i.e., value architecture).
* **Activity Architecture** defines the composition and structure of the innovation ecosystem that may emerge around the core platform. Aspects of activity architecture include not only who and in which roles, but also, (co-)specialization drivers and coordination mechanisms. The definition of participant roles defines the specialized competencies participants develop, and therefore, cements the long-term configuration of the activity network.
* **Value Architecture** describes the resulting value dynamic, as defined by the interplay between technological architecture and activity architecture. Key aspects of value architecture were already discussed above.

As such, although there has been little explicit discussion in the literature on ecosystem creation, we believe that the complex nature of innovation ecosystems requires the coordination of strategic activities on at least four levels (Autio, Keil, & Thomas, 2012):

* **Technological Strategies** involve not only technology architectural decisions, as discussed above, but also, standardization strategies, open source strategies, and patenting and licensing strategies, to name a few.
* **Economic Strategies** involve the choice, access, and promotion of complementary assets and associated investment strategies. What will be the value chain functions included in the system, how will these be organized, and how are the necessary assets included within the system?
* **Behavioural Strategies** cover behavioural tactics in the creation of initial network ties and alliances and involve, e.g., persuasion and influencing strategies, as briefly discussed previously.
* **Institutional Strategies** cover the creation of – and connectivity with – institutional structures (both formal and informal) necessary to provide for ecosystem coordination and establish an institutional and regulatory framework to ensure smooth coordination and operation of the ecosystem.

# **5) Conclusion**

Although an increasing literature argues that strategic networks and innovation ecosystems have become the new basis of competition (Gulati et al., 2000; Iansiti & Levien, 2004b; Iyer et al., 2006; Moore, 1993, 1996; Normann & Ramirez, 1993), the managerial implications of this insight remain insufficiently developed. An increasing number of researchers argue that in the ‘information’, ‘knowledge’ or ‘digital’ economy, the ‘innovation ecosystem’ provides the frame of reference for strategy design and implementation (Iyer et al., 2006). Specific tasks involved in innovation ecosystem strategies include ecosystem creation; ecosystem coordination; optimization of business models to take advantage of ecosystem externalities; and the creation of control strategies to ensure value appropriation. The basis for managerial insights remains fragmented, reflecting the general fragmentation of this important domain.

In this paper, we have summarized emerging empirical and conceptual insights regarding innovation ecosystems and outlined areas and tasks where they matter for managerial practice. We hope that the insights offered in this research will prompt further explorations into this important research topic.

# **References**

Adner, R. 2006. Match your innovation strategy to your innovation ecosystem. Harvard Business Review, 84: 98.

Adner, R., & Kapoor, R. 2010. Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. Strategic Management Journal, 31: 306-333.

Afuah, A. 2000. How much do your co-opetitors' capabilities matter in the face of technological change? Strategic Management Journal, 21: 397-404.

Afuah, A. 2004. Does a focal firm's technology entry timing depend on the impact of the technology on co-opetitors? Research Policy, 33: 1231-1246.

Agerfalk, P. J., & Fitzgerald, B. 2008. Outsourcing to an unknown workforce: Exploring opensourcing as a global sourcing strategy. MIS Quarterly, 32: 385-409.

Anderson, J. C., Hakansson, H., & Johanson, J. 1994. Dyadic Business Relationships within a Business Network Context. Journal of Marketing, 58: 1.

Autio, E., Keil, T., & Thomas, L. D. W. 2012. Tilting the playing field: Towards a strategic theory of endogenous action. Working Paper: 1-46.

Barabási, A. L. 2002. Linked: The New Science of Networks. New York: Perseus.

Barabási, A. L., & Albert, R. 1999. Emergence of scaling in random networks. Science, 286: 509. Barney, J. B. 1991. Firm resources and sustained competitive advantage. Journal of Management,17:99-120.

Basole, R. C. 2009. Visualization of interfirm relations in a converging mobile ecosystem. Journal of Information Technology, 24: 144-159.

Bercovitz, J., Jap, S. D., & Nickerson, J. A. 2006. The Antecedents and Performance Implications of Cooperative Exchange Norms. Organization Science, 17(6): 724-740.

Bosse, D. A., Phillips, R. A., & Harrison, J. S. 2009. Stakeholders, Reciprocity, and Firm Performance.Strategic Management Journal, 30(4): 447-456.

Bovet, D., & Martha, J. 2000. Value Nets: Breaking the Supply Chain to Unlock Hidden Profits. New York: Wiley and Sons.

Casciaro, T., & Piskorski, M. J. 2005. Power imbalance, mutual dependence, and constraint absorption: A closer look at resource-dependence theory. Administrative Science Quarterly, 50(June): 167-199.

Chesbrough, H. W., & Appleyard, M. M. 2007. Open innovation and strategy. California Management Review, 50: 57.

Christensen, C. M., & Rosenbloom, R. S. 1995. Explaining the attacker's advantage: Technological paradigms, organizational dynamics, and the value network. Research Policy, 24: 233-257.

Christopher, M., & Gaudenzi, B. 2009. Exploiting knowledge across networks through reputation management. Industrial Marketing Management, 38(2).

Cohen, D. 2002. All the world's a net. New Scientist, 174: 24-29.

Cusumano, M. A., & Gawer, A. 2002. The elements of platform leadership. MIT Sloan Management Review, 43: 1-8.

Das, T. K., & Teng, B. 2002. A social exchange theory of strategic alliances. In F. J. Contractor, & P.

Lorange (Eds.), Cooperative Strategies and Alliances: 429–460. Oxford: Elsevier Science. Das, T. K., & Teng, B. S. 2003. Partner analysis and alliance performance. Strategic Management Journal, 19: 279-308.

DiMaggio, P. J., & Powell, W. W. 1983. The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 48(2): 147-160.

Doz, Y. L., & Hamel, G. 1998. Alliance Advantage: The Art of Creating Value through Partnering. Boston, MA: Harvard Business School Press.

Dyer, J. H., & Nobeoka, K. 2000. Creating and managing a high-performance knowledge-sharing network: the Toyota case. Strategic Management Journal, 21(3): 345.

Dyer, J. H., & Singh, H. 1998. The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage. Academy of Management Review, 23(4): 660 679.

Evans, D. S., Hagiu, A., & Schmalensee, R. 2006. Invisible Engines: How Software Platforms Drive Innovation and Transform Industries. Cambridge, MA, USA: The MIT Press.

Frels, J. K., Shervani, T., & Srivastava, R. K. 2003. The Integrated Networks Model: Explaining Resource Allocations in Network Markets. Journal of Marketing, 67: 29-45.

Funk, J. L. 2009. The emerging value network in the mobile phone industry: The case of Japan and its implications for the rest of the world. Telecommunications Policy, 33: 4-18.

Gawer, A., & Cusumano, M. A. 2002. Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation. Boston, MA: Harvard Business School Press.

Gawer, A., & Cusumano, M. A. 2008. How companies become platform leaders. MIT Sloan Management Review, 49: 28.

Granovetter, M. 1985. Economic action and social structure: the problem of embeddedness. American Journal of Sociology, 91(3): 481-510.

Gulati, R., Nohria, N., & Zaheer, A. 2000. Strategic networks. Strategic Management Journal, 21(3): 203-215.

Gulati, R., Puranam, P., & Tushman, M. L. 2012. Meta-organization design: Rethinking design in interorganizational and community contexts. Strategic Management Journal, 33(6): 571- 586.

Halinen, A., Salmi, A., & Havila, V. 1999. From dyadic change to changing business networks: an analytical framework. Journal of Management Studies, 36: 779-794.

Hallen, B. L. 2008. The causes and consequences of the initial network positions of new organizations: From whom do entrepreneurs receive investments. Administrative Science Quarterly, 53: 685-718.

Hallen, B. L., & Eisenhardt, K. M. 2012. Catalyzing strategies and efficient network tie formation: how entrepreneurs obtain venture capital. Academy of Management Journal, 55(1): 35-70.

Huemer, L. 2006. Supply Management - Value Creation, Coordination and Positioning in Supply Relationships. Long Range Planning, 39: 133-153.

Hughes, M., Ireland, R. D., & Morgan, R. E. 2007. Stimulating dynamic value: Social capital and business incubation as a pathway to competitive success. Long Range Planning, 40(2).

Human, S. E., & Provan, K. G. 1997. An emerging theory of structure and outcomes in small-firm strategic manufacturing networks. Academy of Management Journal, 40(2): 368-403.

Iansiti, M., & Levien, R. 2004a. The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability: Harvard Business School Press.

Iansiti, M., & Levien, R. 2004b. Strategy as ecology. Harvard Business Review, 82: 68-78.

Iyer, B., Lee, C.-H., & Venkatraman, N. 2006. Managing in a Small World Ecosystem: Some Lessons from the Software Sector. California Management Review, 48: 28-47.

Jacobides, M. G., Knudsen, T., & Augier, M. 2006. Benefiting from innovation: Value creation, value appropriation and the role of industry architectures. Research Policy, 35: 1200-1221.

Jarillo, J. C. 1988. On strategic networks. Strategic Management Journal, 9(1).

Kang, J., & Afuah, A. 2010. Profiting from innovations: the role of new game strategies in the case of Lipitor of the US pharmaceutical industry. R&D Management, 40: 124-137.

Knight, L. 2002. Network learning: Exploring learning by interorganizational networks. Human

Relations, 55(4).

Kragh, H., & Andersen, P. H. 2009. Picture this: Managed change and resistance in business network settings. Industrial Marketing Management, 38: 641-653.

Larson, A. 1992. Network dyads in entrepreneurial settings - a study of the governance of exchange relationships. Administrative Science Quarterly, 37(1).

Lee, S. M., Lim, S.-B., & Soriano, D. R. 2009. Suppliers’ Participation in a Single Buyer Electronic Market. Group Decision and Negotiation, 18: 449-465.

Li, F., & Whalley, J. 2002. Deconstruction of the telecommunications industry: from value chains to value networks. Telecommunications Policy, 26: 451-472.

Li, Y.-R. 2009. The technological roadmap of Cisco's business ecosystem. Technovation, 29: 379-386.

Lin, Y., Wang, Y., & Yu, C. 2010. Investigating the drivers of the innovation in channel integration and supply chain performance: A strategy orientated perspective. International Journal of Production Economics, 127: 320-332.

Lusch, R. F., Vargo, S. L., & Tanniru, M. 2010. Service, value networks and learning. Journal of the Academy of Marketing Science, 38: 19-31.

Michel, S., Brown, S. W., & Gallan, A. S. 2008. Service-logic innovations: How to innovate customers, not products. California Management Review, 50: 49-66.

Michel, S., Vargo, S. L., & Lusch, R. F. 2008. Reconfiguration of the conceptual landscape: a tribute to the service logic of Richard Normann. Journal of the Academy of Marketing Science, 36: 152-155.

Miles, R. E., & Snow, C. C. 1986. Network Organizations: New Concepts for New Forms. California Management Review, Spring.

Möller, K. 2010. Sense-making and agenda construction in emerging business networks — How to direct radical innovation. Industrial Marketing Management, 39: 361-371.

Möller, K., & Rajala, A. 2007. Rise of strategic nets--New modes of value creation. Industrial Marketing Management, 36: 895-908.

Möller, K., Rajala, A., & Svahn, S. 2005. Strategic business nets: their type and management. Journal of Business Research, 58: 1274-1284.

Möller, K., & Svahn, S. 2003. Managing strategic nets: a capability perspective. Marketing Theory, 3(2): 201–226.

Möller, K., & Svahn, S. 2006. Role of Knowledge in Value Creation in Business Nets. Journal of Management Studies, 43: 985-1007.

Möller, K., & Svahn, S. 2009. How to influence the birth of new business fields — Network perspective. Industrial Marketing Management, 38: 450-458.

Moore, J. F. 1993. Predators and prey: a new ecology of competition. Harvard Business Review, 71: 75-86.

Moore, J. F. 1996. The Death of Competition: Leadership and strategy in the age of business ecosystems. New York, NY: HarperBusiness.

Mouzas, S., Henneberg, S., & Naudé, P. 2008. Developing network insight. Industrial Marketing Management, 37: 167-180.

Nalebuff, B., & Brandenburger, A. M. 1996. Co-opetition: HarperCollinsBusiness.

Newman, M. E. J. 2001. The Structure of Scientific Collaboration Networks. Paper presented at the Proceedings of the National Academy of Sciences.

Normann, R. 2001. Reframing Business: When the Map Changes the Landscape. Winchester:

Wiley. Normann, R., & Ramirez, R. 1993. From value chain to value constellation: designing interactive strategy. Harvard Business Review, 71: 65-65.

Nosella, A., & Petroni, G. 2007. Multiple network leadership as a strategic asset: The Carlo Gavazzi Space case. Long Range Planning, 40(2).

Oberg, C., Henneberg, S., & Mouzas, S. 2007. Changing network pictures: Evidence from mergers and acquisitions. Industrial Marketing Management, 36: 926-940.

Ozcan, P., & Eisenhardt, K. M. 2009. Origin of alliance portfolios: entrepreneurs, network strategies, and firm performance. Academy of Management Journal, 52(2): 246-279.

Pagani, M., & Fine, C. 2008. Value network dynamics in 3G–4G wireless communications: A systems thinking approach to strategic value assessment☆. Journal of Business Research, 61: 1102- 1112.

Parolini, C. 1999. The Value Net: A Tool for Competitive Strategy. Chichester: Wile and Sons.

Pierce, L. 2009. Big losses in ecosystem niches: how core firm decisions drive complementary product shakeouts. Strategic Management Journal, 30: 323-347.

Porter, M. E. 1980. Competitive Strategy: Techniques for Analyzing Industries and Competitors. New York: Free Press.

Porter, M. E. 1985. Competitive Advantage: Creating and Sustaining Superior Performance. New York: Free Press.

Powell, W., Koput, K., & Smith-Doerr, L. 1996. Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology. Administrative Science Quarterly, 41(1): 116-145.

Prahalad, C. K., & Hamel, G. 1990. The core competence of the corporation. Harvard Business Review: 275-292.

Rabinovich, E., Knemeyer, A. M., & Mayer, C. M. 2007. Why do Internet commerce firms incorporate logistics service providers in their distribution channels? The role of transaction costs and network strength. Journal of Operations Management, 25(3).

Ritter, T., Wilkinson, I. F., & Johnston, W. J. 2004. Managing in complex business networks. Industrial Marketing Management, 33: 175-183.

Rosenfeld, S. A. 1996. Does cooperation enhance competitiveness? Assessing the impacts of inter- firm collaboration. Research Policy, 25: 247-263.

Santos, F. M., & Eisenhardt, K. M. 2005. Organizational boundaries and theories of organization. Organization Science, 16: 491-508.

Santos, F. M., & Eisenhardt, K. M. 2009. Constructing Markets and Shaping Boundaries: Entrepreneurial Power in Nascent Fields. Academy of Management Journal, 52: 643-671.

Scott, W. R. 2007. Institutions and Organizations: Ideas and Interests (3rd ed.). London, UK: Sage Publications.

Steen, John, et al. "Understanding the Innovation Ecosystem in Mining and What the Digital Revolution Means for It." Extracting Innovations: Mining, Energy, and Technological Change in the Digital Age.(CRC Press, New York, 2018) (2018).

Singer, J. G. 2006. Systems marketing for the information age. MIT Sloan Management Review, 48: 95.

Stabell, C. B., & Fjeldstad, Ø. D. 1998. Configuring value for competitive advantage: on chains, shops, and networks. Strategic Management Journal, 19: 413-437.

Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing. Research Policy, 15: 285-305.

Teece, D. J. 1998. Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets. California Management Review, 40(3): 55-79.

Teece, D. J. 2007. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strategic Management Journal, 28: 1319-1350.

Thomas, L. D. W., & Autio, E. 2012. Modeling the ecosystem: A metasynthesis of ecosystem and related literatures, Innovation & Entrepreneurship Group Working Papers: 1-40. London: Imperial College Business School.

Thomas, L. D. W., Autio, E., & Gann, D. M. 2012. Architectural leverage: A formal model, Innovation & Entrepreneurship Group Working Papers: 1-35. London: Imperial College Business School. Thompson, J. D. 1967. Organisations in Action. New York: McGraw-Hill.

Thorelli, H. B. 1986. Networks: Between Markets and Hierarchies. Strategic Management Journal, 7: 37-51.

Uzzi, B. 1997. Social structure and competition in interfirm networks: the paradox of embeddness.Administrative Science Quarterly, 42(1): 35-67.

Van De Ven, A. H., & Poole, M. S. 1995. Explaining development and change in organizations. Academy of Management Review, 20: 510.

Vanhaverbeke, W., Gilsing, V., Beerkens, B., & Duysters, G. 2009. The Role of Alliance Network Redundancy in the Creation of Core and Non-core Technologies. Journal of Management Studies, 46(2): 215-244.

Von Hippel, E. 1988. The Sources of Innovation. New York: Oxford University Press.

Watkins, M. D. 2003. Government Games. MIT Sloan Management Review, 44: 91-96.

Weiner, M., Nohria, N., & Hickeman, A. 1997. Value Networks--The Future of the US Electric Utility Industry. MIT Sloan Management Review: 21-35.

Weiss, M., & Gangadharan, G. R. 2010. Modeling the mashup ecosystem: structure and growth. R&D Management, 40: 40-49.

Wincent, J., Anokhin, S., Örtqvist, D., & Autio, E. 2010a. Quality Meets Structure: Generalized Reciprocity and Firm-Level Advantage in Strategic Networks. Journal of Management Studies, 47(4).

Wincent, J., Örtqvist, D., Eriksson, J., & Autio, E. 2010b. The more the merrier? The effect of group size on effectiveness in SME funding campaigns. Strategic Organization, 8(1): 43-68.

Winkler, I. 2006. Network Governance Between Individual and Collective Goals: Qualitative Evidence from Six Networks. Journal of Leadership and Organizational Studies, 12(3): 119-134.

Yli-Renko, H., Autio, E., & Sapienza, H. J. 2001. Social Capital, Knowledge Acquisition, and Knowledge Exploitation in Young Technology-Based Firms. Strategic Management Journal, 22(587-613).

Zott, C., & Huy, Q. N. 2007. How entrepreneurs use symbolic management to acquire resources. Administrative Science Quarterly, 52: 70-105.