

Dynamic Exchange Capabilities for Value Co-creation in Ecosystems

Abstract

Open sources and digital platforms offer significant opportunities for knowledge-intensive entrepreneurship (KIE) firms to participate on the platforms of existing firms while enabling the existing firms to develop dynamic capabilities (DC). However, the processes through which KIE and existing firms co-create and co-capture value from each other in ecosystems remain less understood. Synthesizing the diverse stream of literatures on DC development in ecosystems, entrepreneurial ecosystems development by KIE firms, and service-centred view of value co-creation, we develop what we refer to as a dynamic exchange capabilities (DEC) framework to delineate the processes through which firms co-create and co-capture value in ecosystems. Emphasizing the transience, and potential trajectory of exchanges in ecosystems, we highlight how potential benefits of exchanges in ecosystems may affect the relationships and resource integration of both existing and KIE firms. The implications for the theory and practice of dynamic exchange capabilities for value co-creation are outlined.

1. Introduction

Knowledge-intensive entrepreneurship (KIE) constitutes a key part of an emerging socio-economic phenomenon that drives economic competitiveness and innovative capabilities (Acs, Stam, Audretsch, & O'Connor, 2017). KIE firms are “new firms that are innovative, have significant knowledge intensity in their activity, are embedded in innovation systems, and exploit innovative opportunities in diverse evolving sectors and contexts” (Malerba & McKelvey, 2020, p. 511). Although they operate under different country and sector conditions, KIE firms exhibit a common characteristic of *interacting* more with innovation *systems* than with other new firms irrespective of sector or country of operation (Malerba & McKelvey, 2020). Such interactions with systems have been explained in the regional development literature, which emphasize value creation by firms in related industries at the regional and local levels (e.g., Agrawal & Cockburn, 2003; Asheim, Smith, & Oughton, 2011), and the strategic management literature, which emphasize value creation and capture at the global level coordinated by a focal orchestrator firm (e.g., Acs et al., 2017; Gilbert, Audretsch, & McDougall, 2004).

However, scholars have highlighted the limitations in both the regional development and strategic management literature in accounting for the role of entrepreneurship in new value creation in such systems (e.g., Acs et al., 2017). In the broader effort to illuminate our understanding of role of entrepreneurship in new value creation with regards to KIE firms’ interaction with innovative systems,

several scholars recommend the entrepreneurial ecosystems (EE), which offer digital affordances for entrepreneurial opportunity discovery and pursuit for business model innovation; voluntary horizontal knowledge spill-overs; and cluster-external locus of entrepreneurial opportunities (Autio, Nambisan, Thomas, & Wright, 2018; Song, 2019; Sussan & Acs, 2017). Digital affordances in EE enable KIE firms to engage in exchanges on digital platforms of open innovation as complementors, rather than serving as inputs, for innovation by established firms (Nambisan, Siegel, & Kenney, 2018). By serving as complementors on the platform of existing firms, KIE firms can emerge and thrive while enabling existing firms to develop dynamic capabilities through value co-creation and co-capture in ecosystems (Ceccagnoli, Forman, Huang, & Wu, 2012; Faridian & Neubaum, 2021; Helfat & Raubitschek, 2018).

However, the processes through which KIE firms' exchanges with incumbents enable KIE firms to emerge and thrive while enabling dynamic capabilities (DC) development by existing firms remains less understood. The aim of this study is to develop a dynamic exchange capabilities (DEC) framework to explicate the processes through which existing and KIE firms engage each other in mutually beneficial exchanges for value co-creation and co-capture in ecosystems. Dynamic exchange capabilities (DEC) refers to a firm's ability to facilitate encounters, interactions and engagement with actors for both exploitation and exploration of capabilities on a platform-based ecosystem of value co-creation and co-capture (e.g., Faridian & Neubaum, 2021; Gronroos, 2011; Marcos-Cuevas, Nätti, Palo, & Baumann, 2016; Payne, Storbacka, & Frow, 2008). DEC differs from, and builds on, dynamic capabilities (DC) framework because although both DEC and DC emphasize the matching of internal resources to the changing environment, DC focuses on resource accumulation, replicability, and inimitability from such an inside-out strategic exercise (Teece, Pisano, & Shuen, 1997). However, DEC emphasizes the opportunities in the exchange processes that facilitate resource accumulation, replicability, and inimitability.

Since KIE firms display significant knowledge intensity, are embedded in innovation systems, and exploit innovative opportunities in diverse evolving sectors (Malerba & McKelvey, 2020), DEC is

important to access specific types of resources during the pre-entry, the establishment, and the post-entry phases in specific sectors (Hermanson, McKelvey, & Zaring, 2018) and overcome the paradox of openness for innovation opportunities while protecting internal knowledge and intellectual assets to appropriate value from their innovations within or across sectors (Lassen, Ljungberg, & McKelvey, 2020). Accordingly, DEC requires KIE firms to adopt EE approach to leverage digital platform affordances in ecosystems for entrepreneurial opportunity discovery and pursuit (Autio et al., 2018).

However, DEC will enable existing firms to adopt a fluid and open, rather than closed, boundaries for value co-creation (Chesbrough, 2007; Reypens, Lievens, & Blazevic, 2016) to constantly learn, unlearn, and relearn how the structures of their internal and external boundaries facilitate ambidexterity for entrepreneurial capabilities development (Faridian & Neubaum, 2021; Santos & Eisenhardt, 2005). Accordingly, DEC requires existing firms to adopt a value co-creation approach to emphasize competitive association with and differentiation from actors in exchanges without limiting the role of the actors in the exchange to, for instance, customer, competitor, or supplier. To this extent, DEC draws on the service-centred view of value co-creation in ecosystems, which emphasizes service-for-service exchanges between actors engaged in resource integration to facilitate multi-actor value co-creation in ecosystems for *strategic benefits* beyond competitive advantage (Vargo & Lusch, 2011; 2016).

The article proceeds as follows. First, the paper discusses the conceptual underpinnings of DEC for value co-creation in ecosystem. In this discussion, the paper reviews DC development in ecosystem by existing firms, EE for opportunity discovery and pursuit by KIE firm, and the service-centred view of value co-creation in service ecosystems to address the limitations of DC ecosystems for established firms and EE for KIE firm. Second, the paper presents the DEC framework with associated propositions on its antecedents and outcomes. Subsequently, the study discusses the theoretical and managerial implications of the framework, and suggest avenues for future research.

2. Conceptual Underpinnings of DEC for Value Co-creation in Ecosystems

2.1. DC Development in Ecosystems

DC is an important theoretical framework which extends our understanding on the significance of inimitable resources and capabilities of an organization by emphasizing a firm's ability to "integrate, build, and reconfigure internal and external competences to address rapidly changing external environments" (Teece et al., 1997, p. 516). DC is crucial for organizations because, as a bundle of resources, organizations break down and lose their competitiveness in high-velocity markets where the only constant is change (e.g., Sunder, Ganesh, & Marathe, 2019). Such high velocity markets characterize innovation systems in which the only constant thing is change. To this extent, scholars (e.g., Sunder & Ganesh, 2020) have proposed a DC ecosystem using a systems thinking perspective to capture organizations as complex systems, bundles of capabilities and their interrelationships that facilitate sustained competitive advantage.

Accordingly, Teece (2018) argues for firms to design appropriate business models that enable them to profit from innovation by providing complementary assets to facilitate innovations on open-source platforms. Building on Teece's (2018) argument on profiting from innovations with complementary asset provision, Helfat and Raubitschek (2018) identified innovation capabilities, environmental scanning and sensing capabilities, and integrative capabilities for ecosystem orchestration as the minimum DCs, which are critical for platform leaders to create and to capture value in ecosystems. These authors emphasize innovation capabilities development as the strategic path for ecosystem orchestration based on a platform leader's environmental scanning and sensing capabilities, and integrative capabilities around innovation. However, although Helfat and Raubitschek (2018) emphasized platform-based exchanges in ecosystem, they limit value creation and capture only to the platform orchestrator or leader and ignore other actors on the platform who create and capture value.

Highlighting the importance of other actors on the platform, Faridian and Neubaum (2021) argue for inter-organizational relationships based on asset sharing for DCs development in open-source ecosystems. From such inter-organizational relationships, the authors argue for exploitation- and exploration-oriented network ties to strengthen intrapreneurial capabilities of a firm in dynamic environments. Thus, exploitative-oriented networks enable firms to co-create and to co-capture value

in existing networks for intrapreneurial capabilities development whereas explorative-oriented networks facilitate the cultivation of new networks for future value co-create and co-capture to sustain the firm's intrapreneurial capabilities. However, DC research is yet to establish the processes through which existing firms develop intrapreneurial capabilities on their platforms that enable value co-creation and co-capture with other firms, such as KIE firms. Nonetheless, understanding the value co-creation and co-capture between existing and KIE firms on platform-based ecosystems requires a critical evaluation of the DC framework and its dimensions. These dimensions include the building blocks, input variables, influencing factors, desired outcomes, and assessment yardsticks for DC (Sunder et al., 2019).

First, the building blocks of DCs involve the assumptions and characteristics that underlie DCs for firms. A key assumption of DCs that limits its application to EE is that DC overcomes the limitations of resource-based view (RBV) of the firm, which only focuses on short term competitiveness of firms based on valuable, rare, inimitable, and non-substitutable (VRIN), but not non-VRIN, resources. Thus, DCs enable sustained competitive advantage by ensuring that firms always possess VRIN resources required for competitive advantage at any given period. Based on this assumption, the underlying characteristic of DC is change and dynamism of resources for firms as a result of the changing environment (e.g., Teece, 2007). If change characterizes DCs, then resources considered as non-VRIN at a particular period may become VRIN in another period and vice-versa depending on the changes in specific resources when they come into contact with other resources and the changing environment. Understanding the transitions between VRIN and non-VRIN resources for sustained competitive advantage is essential to meet the reliability requirements of DC, which argues that markets and firms operate in a Schumpeterian world where there is a necessity for creative destruction to constantly create environments of change (Teece, 1997; Peteraf, Di Stefano, & Verona, 2013). Therefore, in an ecosystem, although non-VRIN resources *per se* may not offer competitive advantage, they may offer opportunity to develop VRIN resources for future competitive differentiation.

Second, the input variables dimension of DCs involve the processes, positions and paths of firms which determine DCs for firms. Processes involves managerial and organizational “routines” such as work, behavioral and change processes whereas positions explain current resources such as human, capital, infrastructure, technology, networks among many other resources (Teece et al., 1997; Sunder et al., 2019). However, paths explains the available strategic alternatives for DC development. Strategic alternative emphasize trade-off, instead of alignment, between various alternatives because of the organizational structure and specificity of firm position in value chains. This understanding of strategic alternatives with regards to paths limits the input variables of DC to the internal boundaries of the firm. From an ecosystem perspective, the input variables for DC may involve the firm’s boundaries of efficiency, power, competence, and identity (Santos & Eisenhardt, 2005).

Boundaries of efficiency minimize governance cost for any exchange through a legal understanding of the firm as a governance mechanism that is distinct from the market. However, boundaries of power maximize strategic control over key external forces through the reduction of resource dependence on other firms (to avoid being controlled) and increase the firm’s power in a particular industry (to control the industry). Nonetheless, boundaries of competence maximize the value of a firm’s resource portfolio through a dynamic matching of the resources with the environmental opportunities to gather, exploit, and renew organization-specific, resource-based advantages. Finally, boundaries of identity achieve a coherence between what the firm stands for (mission) and its activities by shaping the *logic* behind managerial actions and the *ethics* that govern the behavior of employees and managers. The implication of these boundaries for the input variables of DC is that firm’s quest to create DCs may affect other firms and resources beyond what the firm controls internally based on the firm as a governance mechanism.

Third, existing research captures the influencing factors of DCs, including endogenous factors such as culture, leadership, firm-specific factors and managerial actions, as well as exogenous factors such as competitors, suppliers and customers, market influence, and social, economic, regulatory and legal factors (Martin, 2011; Moon, 2010; Sunder et al., 2019; Teece, 2007; Teece et al., 1997). Additionally,

interrelated factors such as best practices, path-dependency lock-ins, strategic liabilities, firm's weakness set and strength set among others have been captured as influencing factors of DC for firms. However, the current consideration of influencing factors of DC for firms defines such factors based on transaction-cost approach (benefiting directly from a relationship) to firm exchanges with other firms or actors. The reliance on a transaction-cost approach to define the influencing factors of DCs limits the application of influencing factors to ecosystems. This is because, in ecosystems, a transaction-cost approach to exchanges limits the exchanges to profit (benefit-costs) motives alone at the micro level and leaves out other benefits such as relational benefits at the meso (e.g., triads) and macro (networks) levels (e.g., Chandler & Vargo, 2011; Jacobides, Knudsen & Augier, 2006).

Fourth, the desired outcome for DC for firms emphasizes competitive advantage in both short and long term (Teece 2007; Teece et al., 1997; Sunder et al., 2019). While competitive advantage underlies the very essence of markets for firms, such advantage is currently considered from a fixated perspective for firms, rather than based on what firms offer. This leads to adversarial, instead of allied, tactics and strategies for opportunity discovery from, and pursuit with, those that may be considered as competitors. In fact, if DC emphasizes the meaningfulness and supportiveness of resource heterogeneity for competitive differentiation (Teece et al., 1997), then it makes sense to emphasize the advantages firms enjoy with what they offer, rather than who they are. In an ecosystem, emphasizing the advantages firms enjoy based on their offering may facilitate more alliances for collaborative, rather than competitive, advantages. For instance, Google specializes in software and operating system development but their alliances with device producers or vendors as well as other software producers enable Google to focus more on the collaborative advantage to be enjoyed by making their systems and software more accessible even to those that may be considered competitors.

Finally, the DC framework emphasizes resources accumulation, replicability, and inimitability as key yardsticks for assessing the presence of DC for a firm that has committed to developing DC (Martin, 2011; Teece et al., 1997; Sunder et al., 2019; Zollo & Winter, 2002). While these assessment yardsticks provide a clear understanding of how new capabilities leverage existing ones and vice versa

for transformation of capabilities for the firm, the quest to always rely on existing capabilities to develop new ones can lead to a firm falling into success traps and limiting the extent to which they open their existing internal competences to the rapidly changing external environment (e.g., Wang, Senaratne, & Rafiq, 2015). These success traps often lead to missed opportunities in an environment that changes substantially or totally in the shortest possible time. For instance, Nokia spent so much resources and time in developing their Symbian operating system internally to the extent and ignored other operating systems such as iOS and Android by Apple and Google respectively. However, Nokia's environment changed so rapidly to the extent that their Symbian operating system became obsolete within a short period of time. Ecosystem offers opportunity to exercise greater openness and alignment of internal capabilities with the changing external environment to remain competitive.

In summary, the DC framework resonates naturally with system thinking perspective and thus a firm's orchestration of ecosystems with complementary assets to facilitate value co-creation and co-capture. In particular, the use of exploitation- and exploration-oriented network ties to co-create and co-capture value in ecosystem may facilitate DC development for incumbent firms while enabling KIE firms to emerge and to thrive. However, existing research on the DC framework and its application to ecosystems offers a limited understanding of how exploitative- and explorative-oriented networks facilitate value co-creation and co-capture in ecosystems for DC development by existing firms while enabling KIE firms to emerge and to thrive.

2.2. KIE firms and EE Development

KIE firms, as new and innovative firms, draw on the significant knowledge intensity in their activities to exploit innovative opportunities in diverse evolving sectors and contexts through their embeddedness in innovation systems (Malerba & McKelvey, 2020). While KIE activities occur within and outside of high-tech or highly research-intensive sectors, examining KIE's close interaction with their environment or innovation systems remains fundamental to assess and make specific generalizations about their activities (Gifford & McKelvey, 2019; Malerba & McKelvey, 2020). For

instance, how KIE firms can use their embeddedness in systems to access specific types of resources, during the pre-entry, the establishment, and the post-entry phases in specific industries or sectors helps to assess and generalize entrepreneurial ventures for KIE firms (Hermanson et al., 2018). Nonetheless, KIE firms must overcome the paradox of opening up for collaborative innovation while at the same time protecting their internal knowledge and intellectual assets for greater appropriation of value from such innovations (Lassen et al., 2020).

In managing this paradox, Amankwah-Amoah and Adomako (2021) find contextual ambidexterity, which emphasizes both exploration and exploitation activities of the firm, as a mediator of knowledge integration (exploitation) and innovation (exploration) for entrepreneurial ventures. Nonetheless, such contextual ambidexterity ignores the embeddedness of KIE firms in systems. Considering the embeddedness of KIE firms in systems and the interdependence of actors in such systems to create new value, entrepreneurial ecosystems (EE) has increasingly gained traction to understand the emergence, growth, and context of KIE firms (Acs et al., 2017). According to Autio et al., (2018), EE differ from traditional clusters by their organization around entrepreneurial opportunity discovery and pursuit through the exploitation of digital affordances for business model innovation, voluntary horizontal knowledge spillovers, and cluster-external locus of entrepreneurial opportunities. Digital affordances enable KIE firms to participate as complementors on existing platforms, rather than serving as inputs, for innovation with established firms (Nambisan et al., 2018). These affordances also facilitate EE development by KIE firms (Autio et al., 2018). Spigel and Harrison (2017) propose a process-based view to understand, for instance, how KIE firms' participation on existing platforms for innovation with existing firms facilitate KIE firms' development of EE. Yet, existing research remains limited on such process-based view of KIE interactions and its impact on EE development.

The EE literature offers different perspectives to understand the characteristics of EE that could potentially help to establish the processes through which KIE firms participate on established platforms and emerge from ecosystems (Velt, Torkkeli & Laine, 2020). Among these perspectives, research on geographical location of EE elements emphasizes regional development, clusters, and innovative

milieus (Brown & Mason, 2017; Martínez-Fierro, Biedma-Ferrer, & Ruiz-Navarro, 2019), and largely overlooks the role of systems in explaining the prevalence and performance of entrepreneurship (Acs et al., 2017). However, the agency perspective of EE studies account for the role of systems in explaining the presence and performance of entrepreneurial actions by emphasizing both purposive and mundane interventions by individual and collective actors and interdependent stakeholders influencing EE emergence and development (Cunningham, Menter, & Wirsching, 2019; Erina, Shatrevich, & Gaile-Sarkane, 2017). Nonetheless, the agency perspective lacks analytical frameworks that explicitly outline the causes and effects in such environments beyond the focal actors (Alvedalena & Boschma, 2017).

Although the network perspective of EE outlines some causes of EE development by highlighting how networks at different levels of analysis impact the development of EE (Neumeyer & Santos, 2018; Nicotra, Romano, Del Giudice, & Schillaci, 2018), the network perspective does not sufficiently demonstrate the ways in which networks are connected in an EE for entrepreneurs and their firms (Alvedalena & Boschma, 2017). The context perspective of EE focuses on entrepreneurial innovation and distinguishes EE from clusters, districts, innovation systems based on the interplay between digital and spatial dimensions with actors initiating and accelerating entrepreneurship whereas human and financial actors influence entrepreneurial activity (Autio et al., 2018; Brown, Mawson, Lee, & Peterson, 2019; Spigel & Harrison, 2018; Velt et al., 2020). The context perspective establishes some connectivity in networks through actor initiation, acceleration, and influences of entrepreneurial activity in EE for KIE firms. However, the key challenge with the context perspective is to establish the institutions (and at what spatial scale) that impact on the structure and performance of actors in EE (Alvedalena & Boschma, 2017).

The governance perspective of EE research appears to address the limitations of the context perspective by establishing that while institutions influence entrepreneurial action and rate positively in EE, knowledge spillovers fuel the ecosystem with failure acceptable as part of entrepreneurial culture (Acs, Estrin, Mickiewicz & Szerb, 2018; Acs et al., 2017; Cumming, Werth, & Zhang, 2019). Institutions influence EE through effective resource allocation in a confined space to exploit innovations on a

multisided digital platform, which requires appropriate governance mechanism to regulate internal and external factors, facilitating entrepreneurial action. The governance perspective captures institutions and how they impact the structure and performance of actors in EE. However, there is a lack of a comparative and multi-scalar assessment yardsticks for the structure and performance of EE. The complexity perspective emphasizes entrepreneurship infrastructure for a symbiotic relationship between environment and new venture creation to support ecosystem life-cycle, mechanics and measurement of emergence and formation of elements of EE for KIE firms (Auerswald & Dani, 2017; Liguori, Bendickson, Solomon & McDowell, 2019; Roundy, Bradshaw & Brockman, 2018). Despite providing some important assessment yardsticks to measure the structure and performance of EE, complexity perspective mostly employ static frameworks such as perceptual measures to take a snapshot of EE without considering the systematic evolution of EE over time for KIE.

In emphasizing how EE elements, i.e., institutional arrangements and resource endowments, constrain or enable entrepreneurship in a particular territory, Stam and van de Ven (2021) propose that EE elements are interdependent and co-evolutionary, while those elements have both upward and downward causation of entrepreneurial activity. Upward causation explains how EE elements facilitate new value creation and ventures for KIE firms, downward causation explains how new venture creation affects the established EE elements such as institutional arrangements and resource endowments. Yet, research remains limited on how the interdependence and co-evolution of EE elements facilitate upward and downward causation of entrepreneurial activity for KIE firms in their relationship with existing firms.

2.3. Service-centred View of Value Co-creation in Ecosystems

Value co-creation has been practiced by firms long before the seminal article on what has now become known as the service-dominant (S-D) logic by Vargo and Lusch (2004). However, ever since Vargo and Lusch's article on the S-D logic, value co-creation has gained traction in the literature of various disciplines including marketing, management, strategy, information systems and many others (Vargo

& Lusch, 2017). The understanding of value co-creation in the service-centred view offers some important implications that help to overcome the limitations of the application of DC to ecosystems for existing firms as well as EE development by KIE firm, as established above. The service-centred view emphasizes five main building blocks or characteristics that revolve around value co-creation in ecosystems (e.g., Vargo & Lusch, 2008; 2011; 2016; 2017).

First, the service-centred view argues that value co-creation occurs between actors, including economic and social actors, who have no fixated identity in ecosystems (Breidbach & Maglio, 2016; Ekman, et al., 2016). From the actor perspective, a firm can engage in exchanges with any other firm with the intention of co-creating value and not necessarily limiting the exchanges to value chain positions including suppliers, customers, and competitors among others. The actor perspective of exchanges in value co-creation enables firms, especially incumbents, to overcome the limitations of the DC framework in ecosystems as a result of pursuing competitive advantage with adversarial strategies or tactics instead of pursuing collaborative advantages with alliance strategies or tactics. While the lack of a defined identity for an actor in an exchange relationship makes it challenging to define the scope and parameters of benefits to be derived from the exchange, the adoption of relationship management dynamics with specific actors such as KIE firm can regulate the parameters of the exchange to distinguish between the roles required in such exchanges.

Second, the service-centred view of value co-creation in ecosystems considers resource integration as the basis for actor exchanges in ecosystems (Vargo & Lusch, 2008; 2011). Such resource integration facilitates interactions between emerging and already established resources (Peters, 2016; Peters, Löbler, Brodie et al., 2014). Resource integration as the basis of actor exchanges enables a firm to overcome the limitations of DC development in ecosystem based on the assumption that VRIN, rather than non-VRIN, resources facilitate competitive differentiation. From this perspective, the ability of a firm to integrate resources, both VRIN and non-VRIN, may facilitate exchanges between the firm and other firms such as KIE firms for capabilities development and renewal in ecosystems. However,

since such resources may be heterogeneously distributed in ecosystems, existing firms must develop resource integration capabilities that facilitate both mobility and complementarity of such resource.

Third, the service-centred view of value co-creation considers service, rather than tangible goods or assets, as the unit of exchange between actors in ecosystems (Vargo & Lusch, 2008). With service as a unit of exchange, resources act as distributing mechanisms of service. Service as a unit of exchange helps to overcome the limitations of DC in ecosystems as a result of the transaction-cost approach underlying the endogenous, exogenous and interrelated factors, which influence DC (e.g., *Sunders et al., 2019*). From a service-for-service exchange perspective, a firm's exchanges may transcend transaction-cost orientation in the value chain where they are active to enhancing both complementarity and mobility in parts of the value chain where they are not active with innovation for industry architectures (e.g., *Jacobides et al., 2006*). This ensures that firms can co-create value with internal resources such as the provision of complementary asset, and co-capturing value with and from external resources such as the relationships generated by the complementary asset. Accordingly, service-for-service exchange requires firms to manage exchanges process based on encounters, interactions, and engagement on complementary assets that serve as platforms to build relationships with other firms. Additionally, the firm must develop capabilities to manage orientations of exchange beyond that, which is regulated by transaction-cost mechanisms.

Fourth, the service-centred view considers institutions and institutional arrangements as the enabling and constraining mechanisms of service-for-service exchange between actors engaged in resource integration in ecosystems (Vargo & Lusch, 2016; 2017). While institutions involve devised rules, norms, and beliefs that give meaning and some predictability to exchange activities, institutional arrangements involve the interrelationships between those devised rules, norms, and beliefs among actors in value co-creation. Thus, institutions give meaning to an exchange action, but institutional arrangements facilitate the meaning of exchange action among other exchange actions in value co-creation. Institutions and institutional arrangements as enablers and constrainers of service-for-service exchange helps to overcome the limitation of DC in ecosystems that considers input variables for DC

from an internal boundaries perspective to include the boundaries of the firm that arise based on boundaries of efficiency, power, competence, and identity (Santos & Eisenhardt, 2005). From this perspective, existing firms must develop different exchange orientations to manage exchanges instantiated by a firm's boundaries that extend to other firms such as KIE firms.

Finally, the service-centred view of value co-creation in ecosystems considers the establishment of nested and interlocking ecosystems to endogenously generate institutions and institutional arrangements that enable or constrain service-for-service exchange (Vargo & Lusch, 2016; 2017). Such an establishment includes dyads, triads, simple networks, and complex networks nested and interlocked in relationships in ecosystems (Chandler & Vargo, 2011; Vargo & Lusch, 2016; 2017). An ecosystem is defined as "relatively self-contained, self-adjusting system of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange" (Vargo & Lusch, 2016, p. 161). Establishing nested and interlocking service ecosystems helps to overcome the limitations of the DC framework that emphasizes exploitation of internal competencies instead of exploration of competencies within and outside the internal confines of the firm as a governing mechanism (Wang et al., 2015). This might include the existing firm's platform-based ecosystem interlocked with that of a KIE firm's endogenous EE. Nested and interlocking ecosystems requires existing firms to develop DEC to co-create and co-capture value with actors such as KIE firms for DC development while enabling such KIE firms to emerge and thrive.

3. Building Dynamic Exchange Capabilities for Value Co-creation in Ecosystems

Exchange capabilities enable firms to renew existing resources and capabilities by facilitating an open flow of competencies between a firm's internal and external environments. The DC framework explains this renewal of firm resource through dynamic processes, positions and paths that facilitate resource accumulation, replicability, and inimitability for sustained competitive advantage (Teece, 2007; Teece et al., 1997). The DC framework overcomes the limitations of the RBV of the firm, which assumes that the firm as a bundle of resources breaks down in high-velocity markets. The RBV

emphasizes VRIN, rather than non-VRIN, resources for a firm's competitive advantage (Barney, 1991; Conner, 1991; Schulze, 1992). Although both the DC framework and the RBV consider VRIN resources as the basis for competitive advantage, RBV considers resources as fungible over time whereas DC considers dynamic and irreplaceable resources accumulated within the firm across time.

The assumption of DC is that fungibility of resources in RBV does not sustain firm performance but resource accumulation, replicability, and inimitability under the DC framework sustains firm performance (Teece et al., 1997). However, this is not always the case in practice. For instance, in the case of Nokia and their Symbian operating system development, they emphasized resource accumulation, replicability, and inimitability under the DC framework but their environment changed rapidly to undo almost all the inimitable resources accumulated over time. Therefore, although DC is important for sustained firm performance, DC depends on how firms open-up their internal resources to other firms and their resources in the external environment by developing exchange capabilities to facilitate resource fungibility as well as accumulation, replicability, and inimitability over time.

Grant (1996) distinguishes these resources, including capabilities, into tangible, intangible and human-based resources. Tangible resources involve physical assets such as equipment, machinery, buildings, and financial capital among many others, whereas intangible resources involve invisible assets such as brand image, goodwill, and product quality, among others. Human-based resources involve knowledge assets such as technical know-how, employee expertise and skillsets, and organisational culture, among others. Among these three categories of resources, knowledge asset plays a central role in identifying and integrating all the resources in an effective manner for firm performance (Hedlund & Nonaka, 1993; Lin & Wu, 2014). Indeed, research shows that building internal knowledge management infrastructure for knowledge acquisition, conversion, application and protection affects firm performance (Gold, Malhotra, & Segars 2001; Nguyen, Ngo, Northey, & Siaw, 2018).

While internal infrastructure and knowledge management processes remain important for DC development, they limit DC development only to the internal boundaries of the firm as a governance mechanism. From a firm's boundaries perspective, knowledge management for DC development may

occur within the firm's boundaries of efficiency, power, competence, and identity (e.g., Santos and Eisenhardt 2005). With boundaries of efficiency, the benefits of knowledge management arise from a firm's value chain exchanges facilitated by transaction cost mechanisms. However, boundaries of power emphasizes knowledge management from exchanges that involve strategic relationships to reduce a firm's resource dependence and increase its autonomy. Nonetheless, boundaries of competence stresses the importance of knowledge management in exchanges that match internal resources and capabilities to the ever-changing external environment. Finally, boundaries of identity emphasizes the benefits of knowledge management in exchanges that align a firm's activities to its legally and morally defined identity as a business.

The implication of firm boundaries for knowledge management requires firms to adopt a service-centred view in which both competitive and collaborative exchanges facilitate value co-creation for firms in ecosystems (Vargo & Lusch, 2016; 2017). The service-centred view captures knowledge-based resources, which is referred to as operant resources, as the fundamental source of strategic benefit in ecosystems. These strategic benefits includes the benefits that the firm enjoys based on competitive differentiation from firms and competitive association with firms in the ecosystem. Such benefits requires firms to develop capabilities for a more open exchanges on the platforms that enable value co-creation in the ecosystem and yet offer competitive differentiation from other firms in the ecosystem (e.g., Ceccagnoli et al., 2012; Faridian & Neubaum, 2021). Thomas, Autio, and Gann (2014) identify four typologies of platforms as a) a set of organizational capabilities that enable superior performance, b) the stable center used for a family of products, c) an intermediary between two or more market participants, and d) a system or architecture that supports a collection of complementary technology assets. In this context, exchange platform in ecosystem is defined as an intermediary between two or more market participants which enables encounters, interaction, and engagement between, at least, two actors in an ecosystem. Such an intermediary can be tangible and intangible resources and capabilities – the most important thing is not the specific resource or capability as the platform, but its ability to facilitate exchange processes between at least two actors in an ecosystem.

The exchange processes for which knowledge management in ecosystem is required for strategic benefits can be conceptualized in three main dimensions – including capabilities in exchange platform encounters, interaction, and engagement (Gronroos, 2011; Marcos-Cuevas, Nätti, Palo, & Baumann, 2016; Payne, Storbacka, & Frow, 2008). Exchange platform encounters involve the contact points established on the same platform between, at least, two actors in the ecosystem (Payne et al., 2008). These contact points can be based on contractual agreements such as transactions, subscription, adoption, sign-ups among others or access to the platform in a way that establishes connectivity between one actor and other actor(s) in the ecosystem. Exchange platform interaction refers to the mutual actions in which two or more actors influence the actions of one another in discrete manner beyond the connectivity established by the exchange platform encounter in the ecosystem (e.g., Grönroos 2011). For instance, interactions can be measured by activities that succeed contractual agreements or access to exchange platforms through mutuality of actions by actors involved. Exchange platform engagement refers to the sustained participation by, at least, two actors in the activities of the platform over an extended period with a more purposeful intent (e.g., Marcos-Cuevas et al., 2016). This may involve a broader economic and social element, the creation of longer-term converging goals, and a complex social and economic interdependence. Accordingly, exchange process capabilities involve a firm's ability to *establish connectivity with other actors on* (encounters) an ecosystem platform, *facilitate mutuality of actions between the firm and other actors on the platform* (interactions), and *drive sustained participation in the activities* (engagement) on the platform by actors on the platform.

Within the context of the above conceptualization, the service-centred view makes it abundantly clear that actors involved in value co-creation in ecosystems assume several roles simultaneously and may perceive multiple forms of exchanges on the same exchange platform (Breibach & Maglio, 2016; Ekman et al., 2016). Accordingly, the development of exchange process capabilities for strategic benefits in an ecosystem may involve different exchange orientations, which may emphasize competitive differentiation as well as competitive association of the firm's value creation activities in the ecosystem. Such exchange orientations may include a) innovation development

and support, b) innovation licensing and commercialization, c) market position management, and d) ties and boundaries structures (Faridian & Neubaum, 2021).

Innovation development and support refers to the exchanges in which firms allocate shared portfolio of financial assets to R&D and related activities in order to explore and exploit innovative capabilities in ecosystems. Innovation development and support may facilitate exploration of *variability and novelty* in innovation capabilities, or exploitation of innovation capabilities through incubation of innovative new ventures, and *improving reliability and quality* of innovations for product optimization. Thus, innovation development and support exchange orientation emphasizes innovation capabilities exploration and exploitation in ecosystems.

Innovation licensing and commercialization explains the exchanges through which firms in ecosystems explore and/or exploit the maximum economic potentials of innovations through an access to a generic complementary asset or resource. From innovation licensing and commercialization perspective, a firm can license-out its internal innovation to other actors in the ecosystem to unlock or enhance the economic potentials of such innovation while licensing-in the innovation of other actors in the ecosystem to minimize the cost of developing such innovations internally (e.g., Chesbrough, 2007). Thus, innovation licensing and commercialization exchange orientation focuses on the exploration and exploitation of the economic optimization capabilities of innovations in ecosystems.

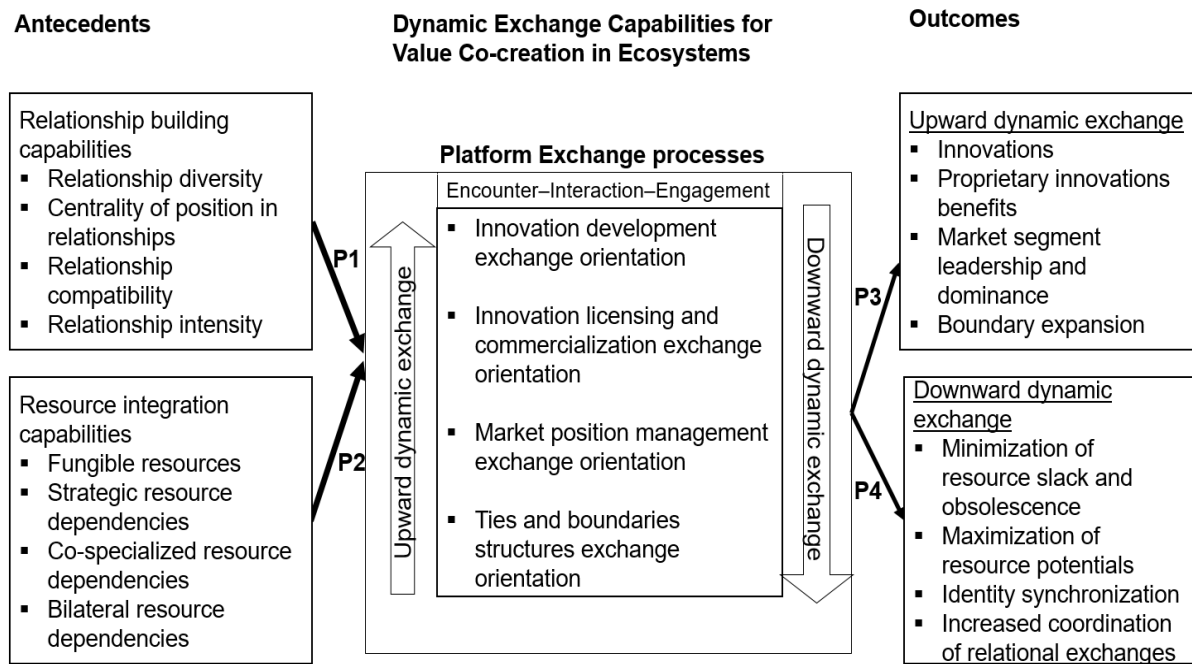
Market position management involves the exchanges in which a firm explores and/or exploits both competitive and collaborative capabilities in the same relationship to establish or maintain market dominance. Market position management enables a firm to share resources in a network characterized by both competition and collaboration, i.e., *co-opetition*, for rapid renewal of innovation and to strengthen market position. This enables a firm to manage exchanges such that competition is not based on reputation, neither is collaboration based on value chain position of firms in a network. Rather, competition and collaboration arise based on resources offered by members in the network. Thus, market position exchange orientation focuses on exploring and exploiting *co-opetition* capabilities to establish or maintain a market position.

Ties and boundary structures explain the exchanges in which a firm explores and/or exploits capabilities in formal and informal relationships for value co-creation and co-capture. Such exchanges are important to leverage value chain relationships through both vertical and horizontal exchanges to enable the firm to co-create and to co-capture value in multi-actor networks. Thus, ties and boundary structures exchange orientation emphasizes the exploration and exploitation of *relationship formalization* capabilities for value co-creation in ecosystems.

Nonetheless, irrespective of whether an existing firm or a KIE firm is engaging in the above exchange orientations for DC development in ecosystems or EE development respectively, ambidexterity plays a major role (Amankwaah-Amoah & Adomako, 2021; Faridian & Neubaum, 2021). Ambidexterity enables both exploration and exploitation of resources and networks so that firms can maintain a reasonable balance between existing and new resources, as well as existing and new networks. Ambidexterity, thus, facilitates upward causation as well as downward causation of dynamic exchanges. Upward causation involves the combination of existing resources and networks to create new resources and networks whereas downward causation explains how new resources and networks enhance existing resources and network configurations (Stam & van de Ven, 2021).

Accordingly, DEC in ecosystems involves exchange process capabilities – capabilities to establish encounters with actors on the same platform (connectivity), facilitate interactions with actors (mutuality of actions), and drive engagement of the actors on the platform over extended period of time (sustained participation). However, these three dimensions of exchange process capabilities apply to exchange orientations such as innovation development, innovation licensing and commercialization, market position management, and ties and boundary structures. Yet such exchange orientations for actors may involve upward causation, i.e., from ties and boundary structures to innovation development, or downward causation, i.e., from innovation development to ties and boundary structures. Figure 1 below articulates the conceptual framework for the dynamic exchange capabilities, and its antecedents and outcomes.

Figure 1: Unpacking dynamic exchange capabilities for value co-creation in ecosystems



3.1. Antecedents Dynamic Exchange Capabilities for Value Co-creation in Ecosystems

3.1.1. *Relationship building capabilities in the ecosystem:* Relationship building capabilities refers to a firm's ability to build a portfolio of dyadic, triadic, simple network, and multi-actor network relationships across sectors, which are nested and interlocked with one another for value co-creation on a platform-based ecosystem (Corsaro, Ramos, Henneberg, & Peter Naudé, 2012; Enz & Lambert, 2012; Vargo & Lusch, 2017). The DC framework highlights the role of networks in building DC (Capaldo, 2007; Dyer & Nobeoka, 2000; Wu, 2010). In ecosystems, established firms may develop DC through ambidexterity in exploration of new network and exploitation of existing network ties for intrapreneurial capabilities development (Faridian & Neubam, 2021). However, for KIE firms, since networks at different levels of analysis affect EE development (Neumeyer & Santos, 2018; Nicotra et al., 2018), they need ambidexterity strategies to address the paradox of openness to innovation and protection of internal knowledge and intellectual assets (Amankwah-Amoah & Adomako, 2021; Lassen et al., 2020). While ambidexterity is important for both established and KIE firms in ecosystems, DC ecosystems and EE

research limit such ambidexterity as a result of defined and static identities of firms from either the sector or value chain positions.

The service-centred view of exchange for value co-creation, rather argues that a firm's exchanges in ecosystems involve generic actor roles that enable fluid transition between specific identities such as supplier, customer, partner, and competitor among other roles (Breidbach & Maglio, 2016; Ekman et al., 2016). Such generic actor role requires firms to develop exchange capabilities beyond dyadic relationships to respond effectively to several other relationships which are jointly connected (Ekman et al., 2016). Accordingly, a firm's participation in value co-creation may motivate the firm to build relationships such as dyads, triads, simple networks and multi-actor networks, which are nested, and interlocked with one another, in the ecosystem (Corsaro et al., 2012; Enz & Lambert, 2012; Vargo & Lusch, 2017).

For existing firms developing DC ecosystems, building nested and interlocking relationships with firms from diverse sectors facilitate greater space of exchanges (Reypens et al., 2016), exploitation of the indirect effect of such exchanges (Han et al., 2012) and recognition and leveraging opportunities for value co-creation in ecosystem (Faridian & Neuubaum, 2021). However, for KIE firms, their embeddedness in innovation systems enables them to draw on diverse relationships from across sectors (Malerba & McKelvey, 2020) to access specific types of resources, across various phases of their development (Hermanson, et al., 2018). Accordingly, capability to draw on diverse relationship may affect exchanges in ecosystems between incumbents and KIE firms across time.

Nonetheless, the service-centred view of value co-creation in ecosystems establishes that a firm's ability to configure multi-actor networks and occupy a key position in those networks enables the firm to easily integrate resources that facilitate value co-creation with and for the actors in those networks (e.g., Corsaro, et al., 2012; Lempinen & Rajala, 2014; Storbacka & Nenonen, 2011). Considering that established and KIE firms may come into exchange with different network backgrounds, each may occupy a central or a key position in their networks which may affect their exchanges. Such a position make the firm's role an entrepreneurial activity in the ecosystem, in which the firm act as an interface

for opportunity identification and business competence development, to harness these opportunities (Kasouf, Darroch, Hultman, & Miles, 2008) in the ecosystem (Acs, Stam, Audretsch, & O'Connor, 2017). As a focal actor, the firm coordinates various actors for individual firms to get a lower cost by exchanging micro-specialized resources within a network of a focal actor than to do so individually on the market (Corsaro et al., 2012; Vargo & Lusch, 2008). For incumbent firms, the key position facilitates exchanges as a platform leader (Helfat & Raubitschek, 2018) and participant in value co-creation and co-capture simultaneously with other firms including KIE firms (Faridian & Neubaum, 2021). However, for KIE firms, key position facilitate exchange as a knowledge intensive firm that exploits innovative opportunities in diverse evolving sectors (Malerba & McKelvey, 2020; Nambisan et al., 2018). Thus, centrality of existing and KIE firms in configured networks in ecosystems leads to different exchange orientations between the firms in specific context.

Further, in the service-centred view, the ability of a firm to link one exchange orientation with another helps to respond rapidly and effectively to the changes in the demands of value co-creation (Enz & Lambert, 2012). Sunder and Ganesh (2020) argue that firms, either incumbent or KIE firms, are complex systems made up of multiple combinations of capabilities and interrelationships, whose effects cannot be attributed to a single relationship or capability in isolation. While some exchanges may require multi-functional teams (Aarikka-Stenroos & Jaakkola, 2012; Enz & Lambert, 2012), others may require uni-functional teams to co-create value (Kohtamäki, Partanen, Parida, & Wincent, 2013; Salomonson, Åberg, & Allwood, 2012). Accordingly, it is important for either established or KIE firm, in its relationship building for value co-creation in ecosystems, to the effectively align different exchange orientations to minimize the economic cost involved in exposing its internal capabilities to the external environment. For incumbents firms, such alignment of exchanges by emphasizing compatibility in a firm's relationship with KIE firms is important to achieve economies of scale (Faridian & Neubaum, 2021). However, for KIE firms, the alignment is important to minimize resource slack in exchanges (Amankwah-Amoah & Adomako, 2021). Accordingly, relationship compatibility

between established and KIE firms may lead to minimal internal costs involved in different exchange orientations.

Finally, while effective alignment of exchange orientations may broadly facilitate minimization of costs in exchanges, exchanges between incumbent and KIE firms in ecosystems may have differing levels of intensity. Intensity of a relationship emphasize the degree of commitment and directions of change in commitment for a given period (e.g., Palmatier, Houston, Dant, & Grewal, 2013). Such intensity requires trust, inclusiveness, and openness to build a relationship that facilitate experimentation and enhancement of market positions (Pera et al., 2016). In value co-creation, research has shown that a more intensive relationship facilitates maximization of exchanges within such relationships (Marcos-Cuevas et al., 2016).

While intensity of relationship may facilitate maximization of exchanges, relationship building capabilities between incumbent and KIE firms may lead to upward dynamic exchange for incumbent firms while it lead to downward dynamic exchange for KIE firms. This is because the established platforms of incumbent firms facilitate capabilities to build relationships to profit from innovations as a platform leader (Faridian & Neubaum, 2021; Helfat & Raubitschek, 2018). However, KIE firms' significant knowledge intensity and innovativeness in diverse sectors leads to relationship building capabilities to access different types of resources at the pre-entry, the establishment, and the post-entry phases of markets in specific sectors (Hermanson et al., 2018). Accordingly, we propose as follows:

P1a) For firms engaged in value co-creation in ecosystems, relationship building capabilities facilitate different exchange orientations i) differently across contexts ii) simultaneously within contexts, iii) to minimize the cost involved in exchanges, and iv) maximize the benefits in exchanges.

P1b) Between existing and KIE firms, relationship building capabilities will facilitate downward dynamic exchanges for KIE firms and upward dynamic exchanges for existing firms.

3.1.2 *Resource integration capabilities*: Resource integration capabilities emphasize the ability of the firm to identify, source, match, and transform the potential relevant tangible and intangible resources for value co-creation in ecosystems (e.g., Peters, 2016; Teece et al., 1997; Vargo & Lusch, 2008). DC

framework captures resource availability as a pre-requisite for the existence or development of DC (Teece, 2007; Lin & Wu, 2014). Existing firms seeking to orchestrate DC ecosystems as platform leaders may offer such resources as complementary assets (Helfat & Raubitschek, 2018) to facilitate value co-creation and co-capture in interorganizational relationships for the development of intrapreneurial capabilities (Faridian & Neubaum, 2021). Such complementary assets and value co-creation is what enables resource accumulation, replicability, and inimitability (Teece et al., 1997). However, KIE firms display a significant intensity in knowledge asset integration, which enables ambidexterity in KIE firms (Amankwah-Amoah & Adomako, 2021) to facilitate EE development as agents or stakeholders (Cunningham et al., 2019; Erina et al., 2017). Thus, both existing and KIE firms engage in exchanges as a result of resource integration. However, both DC ecosystems and EE emphasize resource integration by assuming that resources are inherently defined irrespective of how those resources create value.

The service-centred view of resource integration argues that resources are not; however, they become through their interaction with other resources in systems (e.g., Vargo & Lusch, 2011). To this extent, the 'resourceness' of resources based on their integration have been classified as emergence or summative in nature (Peters, 2016; Peters, Löbler, Brodie et al., 2014). Emergent resource integration refers to "the process of constituting a new entity with its own particular characteristics (i.e. structures, qualities, capacities, textures, mechanisms) through the interactive combination of other, different entities that are necessary to create the new entity, but that do not contain the characteristics present in the new entity" (Smith, 2010, p. 26). However, summative resource integration emphasizes the specific set of interactions that occurs between actors and potential resources during the integration process to enable potential resources such as specific things, persons, machines, money, institutions or concepts acquire resource status (Peters, 2016; Peters, Löbler, Brodie et al., 2014).

Emergent and summative resource integration brings into sharp focus the understanding of resource integration capabilities for complementarity and mobility of resources (Jacobides et al., 2006). Whiles resource integration capabilities in complementary resources enhances the economic potentials of those resources over time, integration capabilities in mobile resources unlocks the economic

potentials of those mobile resources within a short period of time. Therefore, it is important for firms to develop resource integration capabilities to emphasize the appropriate mix of complementary and mobile resources such that current and future needs of the firm can be addressed through DEC development. Such a mix of resources may involve high/low complementarity and mobility of resources (Jacobides et al., 2006).

First, a firm's capability to integrate resources, which are high in mobility but low in complementarity, will enable the firm to benefit from exchange of fungible assets and resources in the ecosystem. Considering that these assets are highly mobile and less complementary, they become easily transferable across different actors within an ecosystem for value co-creation. Although the high mobility of the resources makes them more fungible and therefore liquid, this mobility also predisposes these resources to replication and imitation. For existing firms, integration capabilities in fungible resource facilitate the allocation of funds to support innovation activities of KIE firms (Faridian & Neubaum, 2021). With KIE firms, fungible resource integration capabilities involves capabilities to attract relevant investments through IPOs to scale-up their innovations (e.g., Ceccagnoli, et al., 2012). Thus, integration capabilities in fungible resources facilitate different exchange orientations between existing and KIE firms across time.

Second, a firm's capability to integrate resources with high mobility and high complementarity enables the firm to facilitate strategic resource dependencies for the benefits of a more effective outcome of fungible resources including know-hows, processes, and solutions among others for actors in the ecosystem (e.g., Biggemann et al., 2013; Storbacka, 2011). While the high mobility of these resources make them easily transferable, the high complementarity of such resources requires the resources to interact simultaneously for value co-creation in ecosystems. Integration capabilities in strategic resource dependencies enable a firm to enhance both complementarity and mobility in parts of the value chain where they are not active so they can benefit from both fungible and inimitable knowledge resources (Jacobides et al., 2006). For instance, existing firm such as Intel benefits from selling chips to firms providing IT devices and services, as well as knowledge resources that arise from the use of the

IT devices and services so that they can respond simultaneously to the demands of actors based on the mobility and complementarity of Intel's chip. However, for KIE firms, strategic resource dependencies enables them to access such mobile resources at the initial stages of entry into a given sector through licences in order to integrate those complementary resources into their activities during establishment or post-entry (Hermanson et al., 2018). Thus, integration capabilities in strategic resource dependencies may facilitate different exchange orientations between incumbent and KIE firms in specific contexts.

A firm's capabilities to integrate resources with low mobility but high complementarity enables the firm to facilitate the dependencies in co-specialized resources for the purpose of minimizing the cost involved in the dependencies between internal and external resources for the ecosystem. Typically, this resource integration capability facilitates, for instance, licensing, franchising, partnering, or outsourcing arrangements to unlock or enhance the economic potentials of such resources internally and externally (Chesbrough, 2007; Santos & Eisenhardt, 2005). Considering that specialized resources are less mobile but highly complementary, firms commit them to exchanges that facilitate effective alignment of these specialized resources for greater multipliability of the resources in the ecosystem (e.g., Maiti, Krakovich, Shams, & Vukovic, 2020). For existing firms, integration capabilities in co-specialized resource involves market assets or reputational assets that enable a firm to align internal resources with external resources for exchanges that minimize the cost of holding on to internal resources compared to the use of external resources (Chesbrough, 2007; Faridian & Neubaum, 2021). However, for KIE firms, integration capabilities in co-specialized resource facilitates protection of knowledge and intellectual assets while opening up for collaborative innovation to enhance its internal knowledge resources (Lassen et al., 2020). Thus, integration capabilities in co-specialized resources will lead to different exchange orientations between existing and KIE firms to minimize internal cost.

Finally, a firm's capabilities to integrate resources with low mobility and low complementarity enables the firm to facilitate bilateral dependencies between resources whose benefits emanates from a conscious effort to unlock or enhance the economic potentials of those resources in ecosystems (e.g., Jacobides et al., 2006). Considering that these resources have low mobility and complementarity, they

represent the core competencies which are extremely difficult to imitate unless the actors with those capabilities open up these resources to opposite resources for a conscious development of those resources in the ecosystem. Accordingly, for both existing and KIE firms, bilateral resource dependencies require a conscious effort to develop these resources in exchanges involving trusted and committed parties. Bilateral resource dependencies may drive exchanges based on formal agreements to ensure maximization of the potentials of such resource dependences between existing and KIE firms (Faridian & Neubaum, 2021).

Nonetheless, resource integration capabilities for exchanges between existing and KIE firms could lead to a downward dynamic exchange for existing firms and an upward dynamic exchange for KIE firms. This is because while existing firms integrate resources for exchanges with KIE firms in order to increase its intrapreneurial capabilities internally, KIE firms integrate resources to facilitate exchanges with existing firms in order to scale-up their innovations and access market opportunities (Faridian & Neubaum, 2021; Lassen et al., 2020). Accordingly, we propose as follows:

P2a) For firms engaged in value co-creation in ecosystems, resource integration capabilities will affect its ability to facilitate different exchange orientations i) differently across contexts ii) simultaneously within contexts, iii) to minimize the cost involved in the exchanges, and iv) maximize the benefits in exchanges.

P2b) However between incumbent and KIE firms, resource integration capabilities will facilitate upward dynamic exchanges for KIE firms and downward dynamic exchanges for incumbent firms.

3.2. Outcomes of dynamic exchange capabilities in ecosystems

Research on DC development in ecosystems by existing firms argues that platform-based ecosystems facilitate exploitation of knowledge spillovers (Han et al., 2012), sustained competitive advantage (Sunder & Ganesh, 2020), profit from innovation (Helfat & Raubitschek, 2018), and intrapreneurial capabilities development (Faridian & Neubaum, 2021). However, for KIE firms, participation in or development of EE facilitates new market entry (Susan & Acs, 2017), business model innovation, exploitation of voluntary horizontal knowledge spill-overs, and exploration of cluster-external locus of

entrepreneurial opportunities (Amankwah-Amoah & Adomako, 2021; Autio et al., 2018). While both DC ecosystems and EE emphasize internal outcomes of participation in or development of exchanges by firms in ecosystems, the service-centred view emphasizes a systemic perspective for the outcome value co-creation (Marcos-Cuevas et al., 2016; Reypens et al., 2016). From a systemic perspective, participation in or development of exchanges in ecosystems may facilitate both upward and downward outcomes (Stam & van de Ven, 2021), which may in turn affect the firm's internal resources and capabilities as well as its relationship with other firms in the networks involved in such exchanges for value co-creation in ecosystems (Jacobides et al., 2006; Santos & Eisenhardt, 2005).

With an upward outcome in exchanges between existing and KIE firms, either side benefits from new capabilities which, was originally not present prior to the exchanges between the two. Such benefits from new capabilities involve innovations, proprietary rights to innovations, market leadership and dominance, and firm boundary expansion (Faridian & Neubaum, 2021). Given innovation, existing and KIE firms can benefit from incremental to radical innovations as a result of the exchanges between the existing resources of the existing firm and the significant knowledge intensity and innovativeness of KIE firms. Proprietary rights to innovation involves the benefits that existing and KIE firms derive from exchanges with each other as a result of access to resources which are protected by intellectual property rights. Market leadership and dominance emphasize the benefits derived by existing and KIE firms from each other to consolidate their market position or expand to new markets as a result of the complementarity between the resources of both. With firm boundary expansion as an outcome of upward exchange between existing and KIE firms, both firms benefit from exchanges between each other by expanding their network boundaries because of their dynamic exchange relationship. Accordingly, we propose that:

P3: An upward dynamic exchange between existing and KIE firms in ecosystems will lead to a) innovation benefits, b) rights to proprietary innovations, c) market segment leadership and dominance, and d) boundary expansion for both existing and KIE firms

However, with a downward outcome in exchanges between existing and KIE firms, either side benefits from enhanced capabilities as a result of the feedback or integration of new capabilities into the existing capabilities prior to the exchanges (Faridian & Neubaum, 2021; Stam & van de Ven, 2021). These outcomes essentially affect the firm's participation in a particular value chain or industry architecture (Gunasekaran Lai, & Cheng, 2008; Jacobides et al., 2006), and thus the firm's boundaries of efficiency, competence, identity, and power in ecosystems (Santos & Eisenhardt, 2005). Regarding boundaries of efficiency, existing and KIE firms may benefit from minimal resource slack and obsolescence because of the exchange mechanisms that enable dynamic flow of both mobile and complementary resources between both parties. Boundaries of competence also facilitate growth in the resource disposition of both existing and KIE firms because of the alignment of their resources to different exchange orientations to maximize the potentials of those resources in ecosystems. Regarding this boundaries of identity, existing and KIE firms can derive benefits of identity synchronization in ecosystems as a result of the structure of the exchanges between the parties in ways that are consistent with what the firm stands for (mission). In addition, boundaries of power facilitate the benefit of achieving autonomy by either party in the ecosystem to maximize strategic control of critical strategic resources and to occupy a position of influence to coordinate exchanges in the ecosystem. Accordingly, we propose that:

P4: A downward dynamic exchange between existing and KIE firms will lead to a) minimization of resource slack and obsolescence, b) maximization of resource potentials, c) firm identity synchronization, and d) increased coordination of relational exchanges for either party in the ecosystem.

4. Discussions and Future Research

4.1. Theoretical Implications

The propositions and conceptual framework in this paper demonstrates how dynamic exchange capabilities can facilitate mutually beneficial exchanges between firms involved in value co-creation and co-capture in ecosystems. The conceptual framework draws on the DC framework (Teece, 2007; Teece et al., 1997) and its application to innovation ecosystems (Faridian & Neubaum, 2021; Helfat

& Raubitschek, 2018), as well as the service-centred view of multi-actor value co-creation in service ecosystems (Vargo & Lusch, 2011; 2016; 2017) to highlight the underlying dynamism of mutually beneficial exchanges between firms involved in value co-creation and co-capture in interlocking ecosystems. The framework was explained using the exchanges between incumbent and KIE firms as a context to exemplify the processes through which incumbent firms develop DC while enabling KIE firms to emerge. In this vein, the framework offers several important theoretical implications for DC development, knowledge resource management, and ecosystem sustenance or reconfiguration by existing firms.

4.1.1. DC ecosystems for resource development: First, by establishing resource integration capabilities as a determinant of DEC, the framework offers an important theoretical implication for the RBV of the firm by highlighting on the need to integrate both VRIN and non-VRIN resources for competitive differentiation. It is well-established that VRIN, rather than non-VRIN, resources offer short term competitive advantage (Barney, 1991; Schulze, 1992), and mediate DC to improve firm performance (Lin & Wu, 2014). However, our framework suggests that by developing resource integration capabilities, non-VRIN resources of an existing firm can be combined with VRIN resources of other actors such as KIE firms in ecosystems to facilitate exchanges that can improve the existing firms' performance.

In addition, the DEC framework emphasizes relationship building capabilities as important antecedent, which enables a firm's relationships such as dyads, triads, networks, and multi-actor networks nested and interlocked with one another in ecosystems to serve as input variables for DC development. The literature on DC makes it abundantly clear that while relationships and networks are important input variables for DC development, different relationships serve different purposes (Capaldo, 2007; Dyer & Nobeoka, 2000; Wu, 2010). On the contrary, relationship building capabilities as antecedent to DEC argues that the same relationship can serve different purposes. Thus, a competitor can become a strategic partner for a different exchange arrangements. In this regard, DEC expands the

understanding of input variables for DC with the view that a relationship between the same actors or firms in an ecosystem can serve as an input for different exchanges between those actors, and lead to different outcomes for the actors at different times.

Further, although the DC framework establishes various endogenous (internal to firm), exogenous (external to firm) and inter-related (cutting across internal and external environments) factors that may either constrain or enable firm to create and capture value, these factors have been considered from a closed business model perspective (Martin, 2011; Moon, 2010; Sunder et al., 2019; Teece, 2007; Teece et al., 1997). This hampers minimization of obsolete or unused capabilities internally and maximization of new capabilities available externally. The DEC framework emphasizes exchange process such as encounters, interactions, and engagement as strategic actions that enable a firm to co-create and co-capture value with other actors in platform-based ecosystems. Thus, the enabling or constraining elements of DC development transcends boundaries created by transaction cost mechanisms to include the firm's boundaries of efficiency, power, competence, and identity as influencers of DC development. This requires firms to adopt a more open business model (Chesbrough, 2007) to DC development in order to maximize the advantages in the firm's changing environment while minimizing the potential to fall into success traps based on internal capabilities (Wang et al., 2015).

Nonetheless, DC framework makes it abundantly clear that DC development facilitates sustained competitive advantage (Teece, 2007; Teece et al., 1997). While this perspective is important to highlight competitive differentiation on the market, it leads to the reliance on less collaborative strategies, which have the potential to limit the extent of openness of the firm's internal capabilities to the changing environment. DEC framework, however, requires firms to build capabilities in exchange management such that both competitive differentiation and association or alliance may be facilitated for the firm in its exchanges with the same actor or firm in ecosystems depending on the orientation of the exchange. This approach enables firms to identify areas of DC development in which they can

differentiate themselves from their partners in networks while identifying areas in which they can collaborate with their competitors on the market.

Lastly, existing research on the assessment yardsticks for DC development emphasizes on the development of capabilities internally, but in relationship to other firms in the industry (e.g., Martin, 2011; Sunder et al., 2019; Teece, 2007; Zollo & Winter, 2002). Such internal measures or even external benchmarking of capabilities focuses on areas of DC where the firm is currently performing better compared to others or its own previous performance. As a result, it ignores measures that are based on the external potentials of internal capabilities or internal potentials of externally available capabilities. However, by establishing value co-creation and co-capture as the underlying mechanism for different exchange orientations with actors in ecosystem, DEC highlights on the significance of imitation in developing DC, as well as its potentiality to provide an important measure of DC. From this perspective, a firm can benefit from exchanges that encourage imitation of its internal capabilities. As the value of these capabilities appreciate, the firm is motivated to invest in complementary assets to the imitated capabilities for greater value capture or appropriation (e.g., Jacobides et al., 2006).

4.1.2. KIE and EE development: The DEC framework offers significant theoretical implications for KIE firms and their development in EE through the platforms of established firms. First, while the agency perspective of EE research emphasize purposive and mundane interventions by individual and collective actors and interdependent stakeholders to influence EE emergence and development (Cunningham et al., 2019; Erina et al., 2017), it is not clear how specific actors, other than established or recognized focal actors, influence the development of EE. To provide some clarity in this regard, the DEC framework posits that by building resource integration capabilities, specific actors in an EE such as KIE firms, can influence the configuration of the EE. In many respects, this assertion is consistent with the network perspective of EE research which emphasize that networks at different levels of analysis impact the development of EE (Neumeier & Santos, 2018; Nicotra et al., 2018). However, while the network analysis at different levels assumes a distinction between those levels in EE, DEC extends

the argument by emphasizing relationship building capabilities that connect networks at different levels to one another as a result of a specific actor's engagement in different exchange orientations upward or downward. Therefore, by building relationship capabilities, actors or firms, including KIE firms, can easily identify and focus on upward or downward exchanges which provide the maximum impact on the ecosystem to either maintain or reconfigure the ecosystem to their benefit. Establishing relationship building capabilities as antecedent to upward and downward dynamic exchanges clarify the ways in which elements in networks are connected in EE (Alvedalena & Boschma, 2017; Stam & van de Ven, 2021).

It is well argued in the literature on EE that actors in EE initiate and accelerate entrepreneurial innovation whereas human and financial resources influence this innovation in specific contexts (Autio et al., 2018; Spigel & Harrison, 2018; Velt et al., 2020). And while digital affordances may play a major role in such contexts, the main factors that enable or constrain EE development involves innovation. Such innovation in those contexts may be initiated, accelerated, and influenced by actors from diverse background of sectors. By highlighting on exchange processes through encounters, interactions, and engagement, the DEC framework provides an alternative means to enable KIE firms to identify the impact of various institutions and actors on the structure and performance of actors in EE. This implies that KIE firms can identify and pursue opportunities to optimize innovation for various sectors and avoid the potential of falling into a trap by engaging in constant innovation without considering the relevance and timing of such innovations.

In addition, EE research on governance perspective suggests that institutions that influence EE positively through effective resource allocation in a confined space to exploit innovations on a multisided digital platform, must deploy governance mechanisms that regulate their internal and external factors to facilitate the fuelling of the ecosystem with knowledge spillovers (Acs et al., 2018; Acs et al., 2017; Cumming et al., 2019). However, fuelling and ecosystem with knowledge spillovers requires such institutions driving entrepreneurial action in EE to identify areas of competitive differentiation and association with actors in the ecosystem. The DEC framework emphasizes different

exchange orientations through the upward or downward trajectory, which enables KIE firms to clearly differentiate between exchanges that requires competitive differentiation from, or association with, actors in the ecosystem.

More so, EE complexity perspective requires KIE firms to build entrepreneurship infrastructure to facilitate a symbiotic relationship between their current environment and new venture creation in ways that capture the dynamics of emergence and formation of elements of EE for KIE firms (Auerswald & Dani, 2017; Liguori et al., 2019; Roundy et al., 2018). While this approach seems to focus on the same actors and elements that KIE firms engage across time (Stam & van de Ven, 2021), the approach ignores the inherent benefits in the same exchange orientation that can ensue between KIE firm and different actors or firm over time. However, by delineating the exchange orientations between KIE firms and other firms across time, we show that KIE firms can benefit from differentiation by protecting their intellectual properties from innovation-oriented exchanges while opening avenues for commercialization of such innovations in other exchange orientation(s).

4.1.3. Service ecosystems for exchange development: The service ecosystem literature emphasize that value co-creation occurs between actors, including economic and social actors, who have no fixated identity in ecosystems (Breidbach & Maglio, 2016; Ekman et al., 2016). While this enables opportunities to maximize exchanges for value co-creation in ecosystems, DEC draws attention to relationship building capabilities required for a firm to identify and separate strategic opportunities in exchanges from the threats in the relationships that facilitate those exchanges in ecosystems. Additionally, the service-centred view argues for resource integration as a key driver of value co-creation in ecosystems (Peters, 2016; Peters et al., 2014). Resource integration enables firms to compete and collaborate with other actors or firms based on resource exchanges for value co-creation in ecosystems. Given that the ‘resourceness’ of a resource can be ascertained and appraised by its ability to facilitate service for actors engaged in value co-creation in ecosystems (Vargo & Lusch, 2011), DEC expands the understanding of resource integration for value co-creation by proposing that firms build resource integration

capabilities that separate the potentials of resources from the ownership of those resources to facilitate optimization of resources in exchanges for value co-creation.

From the service centred-view, service is the unit of exchange between actors engaged in resources integration for value co-creation (Vargo & Lusch, 2008; 2017). This service-for-service exchange enables a firm to assume multiple roles in an exchange relationship with actors involved in value co-creation in ecosystems to facilitate exchanges beyond those constrained or enabled by transactions (Ekman et al., 2016). The DEC framework maintains this understanding but goes beyond it to argue that firms should differentiate relationships from resources that drive exchanges in those relationships. With this separation, firms or actors with established resources in ecosystems can trace the contact points where those resources offer opportunities for a more productive relationship. Also, firms with established relationships in the ecosystem can trace the contact points where the relationship offer opportunities to explore the potentials of resources in the ecosystem.

The service-centred view considers institutions and institutional arrangements as the enabling and constraining mechanisms of service-for-service exchange between actors engaged in resource integration in ecosystems (Vargo & Lusch, 2016; 2017). Institutions and institutional arrangements enable a firm to identify the governance mechanisms that regulate its exchange of resources internally and externally with other actors within the ecosystem. In this regard, DEC emphasizes the need for firms to build capabilities for different exchange orientations based on resources, and upward and downward orientations based on actors involved in those exchanges. This will help firms to identify competitive association with actors where resources collaboration is required and focus on competitive differentiation from actors where resource competition is involved. Finally, the service-centred view elaborates on the establishment of interlocking and nested service ecosystems of actors engaged in resource integration for value co-creation (Vargo & Lusch, 2016; 2017). Nested ecosystems enable firms to engage in different orientations of exchange in different networks to co-create innovations in one network and market or commercialize the innovation in another network. DEC further illuminates our understanding in this area by proposing that firms develop relationship building and resource

integration capabilities to engage in innovation in one network and commercialize the innovation in another network through platform management.

4.2. Managerial implications

The DEC framework provides some significant managerial implications, particularly, for DC development in ecosystems by existing firms, EE development by KIE firms, and any firm that seeks to participate in value co-creation in ecosystems. For established firms that seek to develop DC ecosystems, the framework suggests that such firms should build open business models that enable a differentiation of relationships from resources and capabilities that facilitate exchange in those relationships. This differentiation remains important in shielding firms from falling into success traps (Wang et al., 2015) by developing individual DCs in isolation (Sunder & Ganesh, 2020). In this regard, firms can collaborate with other firms or actors, who may be considered as competitors, through an effective alignment of internal resources and capabilities with external ones. This however requires DEC's relationship building and resource integration capabilities that minimize internal resource obsolescence and maximize external resource opportunities without compromising competitive differentiation. Also, drawing on DEC implies that firms must provide free access to complementary resources that facilitate exchanges between actors or firms in parts of the value chain where the firm is not active (Jacobides et al., 2006). This would enable firm to learn from encounters, interactions and engagement by actors in different parts of the value chain where they are not active in order to identify specific actors with which to engage in upward dynamic exchanges for innovation support and downward dynamic exchanges to structure boundaries and ties for specific innovation. This upward and downward dynamic exchanges do not only facilitate greater value for orchestrators of platform-based ecosystem to profit from innovations (Helfat & Raubitschek, 2018), they also facilitate ambidexterity for firms to develop DC through exploitation- and exploration-oriented network ties (Faridian & Neubaum, 2021).

In addition, the DEC framework suggest that KIE firms seeking to develop or reconfigure EE to their benefit must focus on relationship building capabilities to establish networks that involve actors from different sectors. Maintaining that KIE firms are embedded in innovation systems, DEC argues that KIE firms can develop relationships with firms from different sectors and separate such relationships from resources that enable exchanges in those relationships. Such differentiation is important for KIE firms to use their embeddedness in systems to access specific types of resources from specific relationship during the pre-entry, the establishment, and the post-entry phases in specific industries or sectors (Hermanson et al., 2018). In addition, given that EE is built around opportunity discovery and pursuit through digital affordances, DEC posits that KIE firms can leverage their embeddedness in systems to learn from encounters, interactions and engagement with specific actors which affords opportunities for collaborative innovation in a downward dynamic exchange, and upward dynamic exchanges to protect their internal knowledge and intellectual assets. Such exchanges remain important for KIE firms to address the paradox of opening up for innovation while protecting key knowledge assets in different relationships and facilitating ambidexterity strategies across contexts of innovation in ecosystems (Lassen, et al., 2020; Amankwah-Amoah & Adomako, 2021).

Finally, the framework suggests that firms seeking to participate in value co-creation in service ecosystems must emphasize a differentiation of relationship building capabilities that enable resource integration from resource integration capabilities that enable relationship building in ecosystems. This is particularly important for firms to leverage their generic actor roles in service-for-service exchange to learn from encounters, interactions, and engagement with different actors in ecosystems. Consequently, these firms are able to identify actors with whom to engage in upward dynamic exchange through functional teams from a single department and utilise downward dynamic exchange through multi-functional teams from multiple departments (Aarikka-Stenroos & Jaakkola, 2012; Enz & Lambert, 2012). Furthermore, firms involved in value co-creation in service ecosystems can leverage their occupation of a position in configured networks to engage in upward dynamic exchanges for

innovations to maintain the existing configurations in the ecosystem to their advantage. In the same vein, firms with key resources or innovations in the ecosystems can engage in downward dynamic exchange with actors occupying key positions in configured networks to alter the configuration of the networks in the ecosystem to their advantage.

4.3. Future Research Directions

The DEC framework offers several avenues for future research to expand our understanding on firm participation in ecosystems, and the orchestration of value co-creation for greater value capture. First, the framework suggests that relationship building capabilities is an important antecedent of relational exchanges in ecosystem of value co-creation. However, a firm's relationships in networks may also involve roles such as competition, partnerships, customer, user, supplier, provider etc, which may require formal and informal arrangements. In this regard, we believe that future research should examine the conditions or circumstance in which specific roles of a firm affect its exchanges, in terms of orientation and direction, with other actors or firms for value co-creation in ecosystems. Second, although the DEC framework emphasize on resource integration capabilities as an important antecedent of exchanges in ecosystems, we are of the view that a firm's ability to integrate both existing and emerging resource capabilities (Peters et al., 2014) would require the firm to identify, match, and reconfigure the potentials of resources. As such, we direct future research to examine the circumstances in which formed and emerging resources affect a firm's relational exchanges, in terms of orientation and direction, for value co-creation in ecosystems.

Third, the DEC framework suggests that platform encounters, interactions, and engagement are three important dimensions of specific exchange orientations for firms involved in value co-creation in ecosystems. However, such dimensions may arise from resources in specific exchange contexts with parties in the exchange. We direct future studies to examine how resources, context, and parties enable platforms encounters, interactions and engagement between firms involved in value co-creation in ecosystems. Fourth, we maintain that different exchange orientations between actors in the same

relationship is an important mechanism that facilitate both competitive differentiation and association for firms involved in value co-creation in ecosystems. However, this competitive differentiation and association may arise from the role of the firms and the resources involved in the exchange. In this regard, future research can examine the conditions in which the role of firms and resources involved in relational exchanges instantiate competitive differentiation and/or association for the firms involved in value co-creation in ecosystems. Finally, our framework suggests that dynamic exchanges between firms involved in value co-creation in ecosystems, on the one hand, comprises an upward exchange outcome which unlock new resources, capabilities, and innovations for firms. And on the other hand, a downward exchange outcome that enhance existing resources, capabilities, and innovations for firms. However, whether the benefits from upward exchange outcomes diminishes or increases the benefits of downward exchange outcomes for a firm involved in exchanges for value co-creation in ecosystems remains an avenue for future academic endeavour to explore.

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