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Entrepreneurship in Innovation Ecosystems: Entrepreneurs' Self-Regulatory Processes and Their Implications for New Venture Success

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Innovation ecosystems have emerged as an important context for entrepreneurship. Ecosystem entrepreneurs, however, face a unique set of challenges associated with the need to balance the goals and priorities set by the ecosystem leader with the goals and priorities of the new venture. We focus on ecosystem entrepreneurs' *self-regulatory processes* and the potential role of these processes in entrepreneurs' efforts to successfully balance requirements set by the ecosystem leader with the goals of their own ventures.

Introduction

In the last several years, large companies in many different industries have established global networks of partners or ecosystems to enhance the reach and range of their products, services and technologies (Chesbrough, 2003; Nambisan & Sawhney, 2007). A business ecosystem has been defined as "an economic community supported by a foundation of interacting organizations—the organisms of the business world" (Moore, 1996, p. 26). More specifically, an innovation ecosystem refers to a loosely interconnected network of companies and other entities that coevolve capabilities around a shared set of technologies, knowledge, or skills, and work cooperatively and competitively to develop new products and services (Moore, 1993). The three defining characteristics of an innovation ecosystem then are the dependencies established among the members (members' performance and survival are closely linked to those of the ecosystem itself), a common set of goals and objectives (shaped by the ecosystem-level focus on a unique customer value proposition), and a shared set of knowledge and skills (complementary set of

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technologies and capabilities) (Adner & Kapoor, 2010; Iansiti & Levien, 2004; Teece, 2009). Examples of such innovation ecosystems include Apple's iPhone ecosystem, Google's Android ecosystem, Salesforce.com's AppExchange network, and the Linux open source community.

In this study, we focus on one type of such innovation ecosystems, a *hub-based innovation ecosystem* that involves a single firm assuming the ecosystem leadership (setting the goals and defining the innovation platform) and exercising considerable influence over the strategies and fortunes of all other members. Such innovation ecosystems have emerged as an important context for entrepreneurship. For example, Apple's iPhone ecosystem has spawned hundreds of startups seeking to develop and market complementary applications (apps) to consumers.[1] The niche nature of the expertise called for and the relatively small size of the value appropriation opportunities presented by these innovation ecosystems (Iansiti & Levien, 2004) tend to attract mainly new ventures and small companies. Further, the gradual infusion of digital content into a wide range of products and services and the consequent increase in the number of digital innovations (Yoo, Henfridsson, & Lyytinen, 2010) have led to innovation ecosystems in consumer goods and other such sectors (e.g., electronic toys, automotive, household appliances, publishing, etc.), thereby opening up a much broader set of opportunities for entrepreneurs.[2] All of these have enhanced the significance of innovation ecosystems as a context for entrepreneurship.

In contrast to entrepreneurs in other market settings, these *ecosystem entrepreneurs* are faced with special challenges. Specifically, they must manage their new ventures while simultaneously keeping in view different sets of potentially conflicting forces emanating from the ecosystem. On the one hand, they must work within the vision, goals, and structures set forth by the ecosystem leader or the hub firm (e.g., Apple). As such, they have to ensure that their company's business objectives and strategies align well with those of the hub firm and the other partners. On the other hand, they must also ensure sufficient differentiation and independence for their companies and pursue a unique value proposition that would sustain the new venture even if the particular innovation platform declines (or fails). Further, success of the platform (and the hub firm) may not always translate into success for the new venture. In other words, there might be potential conflicts between what success means for the ecosystem and what it means for an individual member of that ecosystem. Thus, this calls for an ecosystem entrepreneur to maintain a balance between an "independent" mindset and an "ecosystem" mindset. The new venture's success is likely to be shaped by how well the ecosystem entrepreneur can achieve such a balance. Two key research questions then are as follows: *What are the dimensions of the entrepreneur's cognition and behavior that contribute toward maintaining and/or effectively integrating these potentially conflicting mindsets or roles* and *what specific skills of the entrepreneur predict a new venture's success in an innovation ecosystem*?

Despite the rich set of opportunities offered by innovation ecosystems for new ventures and their significance as a context of entrepreneurship, these (and other related)

1. The large number of iPhone application developers and the considerable revenues they generate (approximately $1.8 billion in 2010—source: iSuppli Market Research; http://www.isuppli.com) has given rise to the notion of the "iPhone economy" in the popular media. Of the 70,000 or so iPhone developers, approximately 20% are new ventures (source: Flurry analytics report, http://www.flurry.com)

2. For example, automobile manufacturers have started integrating various forms of computing capabilities into existing car platforms—capabilities that offer telematics services, entertainment services, etc. (Henfridsson & Lindgren, 2005)—fundamentally altering the nature of their ecosystems and enabling the participation of new ventures not typically associated with the industry.

issues have garnered limited research attention thus far. The extant literature in innovation management has mainly focused on issues faced by the dominant firm or the ecosystem leader (Gawer & Cusumano, 2002; Iansiti & Levien, 2004; etc.), whereas research in entrepreneurship has overlooked innovation ecosystems as a venue for entrepreneurship (Birley, 1985; De Carolis, Litzkey, & Eddleston, 2009).

In this paper, we address the previous two research questions by exploring alternate theoretical perspectives that reflect entrepreneurs' cognitive capabilities to adapt to conflicting demands in the ecosystem. At a broad level, we focus on entrepreneurs' *self-regulatory processes*, the cognitive processes through which individuals monitor, evaluate, direct, and adjust their own behavior so as to progress toward desired goals (Forgas, Baumeister, & Tice, 2009; Zimmerman, 2006). These processes include a broad range of knowledge and skills, and here, we examine the role of several in entrepreneurs' success in effectively guiding their new ventures within the confines of the ecosystem as well as in the broader technology/market environment. There is prior theoretical basis, specifically in upper echelons theory (Hambrick, 2007; Hambrick & Mason, 1984), to suggest the existence of such a link between important aspects of key actors' cognition (here, entrepreneurs' self-regulatory processes) and organizational outcomes (for instance, new venture success).

The importance of self-regulatory processes in the domain of entrepreneurship has previously been recognized by several researchers (e.g., Baron & Henry, 2010; Mitchell, 1994; Mitchell et al., 2007). For instance, Mitchell et al. (p. 14) noted that ". . . metacognitive thinking . . . will lead to the creation of entrepreneurial expertise . . . facilitating the self-reflection, understanding, and control of one's own entrepreneurial cognitions." Similarly, Haynie and Shepherd (2009) had called attention to the adaptive significance, for entrepreneurs, of certain aspects of metacognition.

Here, we suggest that the significance and impact of self-regulatory processes in entrepreneurship will be enhanced in contexts that are marked by the three characteristics of innovative ecosystems identified earlier: strong interfirm dependencies, pursuit of common goals, and evolution of shared complementary capabilities. As we discuss in detail in the next section, self-regulation may be especially crucial for ecosystem entrepreneurs—even more so than for entrepreneurs, in general—given that in order to join and succeed in innovation ecosystems, they must surrender part of their autonomy and independence—two factors that many individuals seek in deciding to become entrepreneurs (e.g., Baron, 2010).

In what follows, we draw on and integrate themes and concepts from prior studies in innovation management, entrepreneurship, and cognitive science to describe the various ways in which entrepreneurs' self-regulatory processes may shape their success in leading their ventures in the ecosystem. Specifically, we focus on three self-regulatory processes: *self-control*; *grit* (which involves consistent interest in or focus on and persistent effort to reach long-term goals); and *metacognition*. We suggest that when they function effectively, these processes enable entrepreneurs to better address two critical challenges they face in their dual roles as "ecosystem follower" and "independent company leader": *managing multiple discrepant goals* and *recognizing innovation and growth opportunities in the ecosystem and beyond*. As we discuss in the next section, these challenges are somewhat unique to the ecosystem context and derive from the nature of dependencies and shared goals and capabilities that exist among the members of an ecosystem.

By discussing the implications of entrepreneurs' self-regulatory processes in innovation ecosystems, we seek to make two key contributions. First, we extend current theory concerning the potential role of self-regulatory processes in entrepreneurship by discussing how certain contextual characteristics (several of which occur in innovation

ecosystems) can combine to enhance the importance of such processes for entrepreneurs. Second, we develop a deeper theoretical understanding of the nature of the adaptations that entrepreneurs (and new ventures) must make to attain success in a context of considerable contemporary importance, namely innovation ecosystems.

The remainder of this discussion is organized as follows. First, we describe the nature of innovation ecosystems and explicate the nature of the challenges that entrepreneurs face in this environment. Following that, we review the literature on several important self-regulatory processes, describing both the nature of these processes and their potential relevance to the situations and tasks faced by ecosystem entrepreneurs. We then focus on each of the challenges mentioned previously and examine how effective use of one or more types of self-regulatory processes can enhance entrepreneurs' success in meeting them. We conclude by identifying the implications for future research and practice in this area.

Innovation Ecosystems and Entrepreneurs

Innovation Ecosystems and the Power of the Hub Firm

As noted previously, members of an ecosystem are bound together by common goals (value propositions or market objectives) and the need to leverage one another's knowledge and capabilities and coevolve to achieve those goals.[3] However, the nature and extent of these dependencies, common goals, and shared capabilities vary and give rise to different types or contrasting forms of innovation ecosystems. Prior studies (e.g., Nambisan & Sawhney, 2007; Pisano & Verganti, 2008) have classified innovation ecosystems into different types based on the nature of governance (centralized/decentralized), the extent of openness of the boundaries (open/closed), the structure of the problem space (well-defined/emergent), the nature of the innovation pursued (incremental/radical), etc. For example, some of the types of innovation ecosystems identified in the literature include hub-based ecosystem, open source community, research and development (R&D) consortium, crowdsourcing ecosystem, etc.

The type of innovation ecosystem that is most prevalent, particularly in the technology sector, is referred to as the *hub-based ecosystem* wherein a single firm establishes and leads the ecosystem—this is also referred to as the platform-based network (Gawer & Cusumano, 2002), the orchestra model (Nambisan & Sawhney, 2007), or the keystone model (Iansiti & Levien, 2004). Examples of this include Apple's iPhone ecosystem, IBM's Power Architecture ecosystem, Intel's microprocessor ecosystem, Pfizer's biotech ecosystem, etc.[4]

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3. These dependencies, common goals, and shared capabilities define the boundaries of an innovation ecosystem and also help demarcate it from the broader industry or sector or regional cluster. While there may be a shared set of industry-level norms and values, firms within an industry/sector/cluster often pursue different sets of market goals or value propositions and/or establish competing/substitute set of technologies, capabilities, and skills to pursue such goals, and as such, experience limited levels of dependencies on one another for their growth and survival.

4. Hub-based ecosystems may also hold a primary focus on operations (rather than on innovation) (Iansiti & Levien, 2004) and examples of such operations-focused ecosystems include Wal-Mart's supplier ecosystem and Amazon's e-business ecosystem. The concentration of new ventures in such ecosystems tends to be much less compared with that in innovation ecosystems, and as such, here we focus primarily on hub-based innovation ecosystems. However, as we note later, the concepts we discuss here apply to new ventures in such operations-focused ecosystems too.

The hub-based innovation ecosystem has become the most fertile context for new firm creation given the numerous benefits associated with membership—instant access to established markets, branding and reputational advantages, access to intellectual property and technical know-how, and enhanced IPO opportunities (Ceccagnoli, Forman, Huang, & Wu, 2012; Eisenmann, Parker, & Van Alstyne, 2009). Indeed, being connected to a powerful platform leader helps new ventures overcome some of the liabilities arising from their newness and inexperience. As such, here, we focus on entrepreneurs and new ventures operating in hub-based innovation ecosystems.

In this type of ecosystem, the hub firm or the ecosystem leader truly "runs the show," defining the common goals or the core value proposition and offering the basic innovation platform that incorporates the shared knowledge and capabilities and serves as the foundation for other members to build on through their own complementary innovations. The hub firm also defines the criteria for membership, selects or screens the partners, and establishes the rules and policies that will govern both value creation and value appropriation.[5] The hub firm may also assume the responsibility to help or guide the partners in innovation as well as to promote their offerings in the market. The broader objective of the hub firm is to establish its innovation platform as the dominant design in that market and to ensure its long-term competitiveness and market appeal.

Thus, based on its role and responsibilities, a hub firm exercises considerable influence on individual partners' strategies and actions (Iansiti & Levien, 2004; Nambisan & Sawhney, 2011).[6] Further, given the size disparities, the hub firm also holds significant power in the ecosystem, and typically, can "make or break" the future of many of the smaller firms through its decisions on membership, technology licenses, nature and extent of knowledge sharing, special alliances and collaborative initiatives, certification and promotion of partner's offerings, etc. All of these introduce a level of tension into the relationship with the hub firm that poses several challenges for entrepreneurs leading their new ventures in the ecosystem.

Critical Challenges for Ecosystem Entrepreneurs

Two broad types of interrelated challenges can be identified for ecosystem entrepreneurs: managing multiple, discrepant goals; and recognizing opportunities within and outside the ecosystem. As we discuss later, both of these derive from the three characteristics that underlie innovation ecosystems (dependencies, common goals, and shared capabilities) and the consequent need for entrepreneurs to play two potentially conflicting roles in the ecosystem—as a *follower* of the ecosystem and its innovation platform and as *the leader* of an independent company.

Managing Multiple and Often Discrepant Goals. The need for entrepreneurs to play dual roles (as ecosystem follower and new venture leader) implies challenges related to potentially discrepant multiple goals—some of which are set by the entrepreneur and

5. For example, in Apple's iPhone ecosystem, Apple serves as the hub firm by offering a technology platform (iPhone) that enables external developers to build complementary applications as well as a marketplace (the iTunes system) that enables partners to appropriate value from their efforts.

6. For example, when Apple announced version 4.0 of the iOS (iPhone operating system), it made a significant change to the license agreement for its iPhone developer program. One section of the agreement was changed to specify that iPhone applications "must be originally written in Objective-C, C, C++, or JavaScript as executed by the iPhone OS WebKit engine"—a move that blocks developers from using cross-platform development tools and third-party development environments. Apple's intention is to discourage its partners from offering the same applications on competing mobile phone platforms (such as Google's Android).

some by the hub firm. Prior studies on collaborative product development (Gawer & Cusumano, 2002; Staudenmayer, Tripsas, & Tuccii, 2000; Weisenfeld, Reeves, & Hunck-Meiswinkel, 2001) have focused on the challenges associated with addressing different types of partner goals in innovation projects. While much of this literature is focused on dyadic partnerships in product development, the nature of the partner goals extend to the ecosystem context too. In particular, drawing on this literature, we focus on three types of goals that assume relevance here: *success or performance goals*; *technology development goals*; and *relational goals*.[7]

The *performance/success goals* and metrics for the new venture and the ecosystem may differ in terms of both scope and time horizon. For example, as an independent company, the new venture's success may be defined in terms of the growth in revenue and profits, number of new offerings, increase in number of employees, market share/size of customer base, reputation of the firm, etc. On the other hand, as an ecosystem follower, success may be defined in terms of the success of the innovation platform itself (i.e., the common performance goals set by the hub firm)—for example, market share of the platform, whether or not the platform has become the dominant design in the market, growth in the number of ecosystem members, reputation of the ecosystem/hub firm, etc. (Adner, 2006; Gawer & Cusumano, 2002). While these may not always be conflicting success goals, in some instances, they might be. For example, the innovation platform's success in the short term may be the number of installations (market reach) even at the expense of short-term profits. On the other hand, for a new venture, short-term profits may be an important success goal given its limited resources.

Similarly, the dual roles faced by entrepreneurs in ecosystems also imply conflicting sets of *technology development goals*. As a member of the ecosystem, an entrepreneur must follow the technological trajectory delineated by the hub firm. In other words, technology development strategies may be set at the level of the ecosystem and members may be required to adopt such strategies. Such technology decisions and choices may relate to the shared capabilities and foundational technologies that constitute the platform, the nature and structure of interactions between the ecosystem members' products/services and the platform, the technologies and tools that members may employ to design and develop their products/services, etc. (Gawer & Cusumano, 2002). At the same time, the entrepreneur may also need to trace an independent technological path for the new venture in terms of investing in and developing unique technological assets that may hold value beyond the ecosystem's boundaries (Teece, 2009). Often, these two sets of technology development goals may be in conflict and pose a critical challenge for entrepreneurs. For example, the hub firm may discourage a member from expanding its technological expertise to areas that overlap with that of the hub firm (and in some cases, with that of other members too). Or a hub firm may promote new technologies that are relatively immature or unproven and force a new venture to adopt them. On the other hand, the entrepreneur may desire to limit the technological risk assumed by the new venture and, as such, pursue a different technological path.

The entrepreneur's need to relate to other ecosystem partners both as competitor and collaborator presents a third set of discrepant goals, namely *relational goals*. In an innovation ecosystem, the technologies, processes, and other innovation assets of a

7. These studies on collaborative product development have also identified other goals that are more focused on operations (e.g., process goals, manufacturing goals, etc.). However, given our focus on hub-based innovation ecosystems and on new ventures' innovation and technology development activities, such operational goals assume limited relevance here.

member firm (e.g., design libraries in the semiconductor industry, assaying stations in the pharmaceutical industry, etc.) can often be leveraged (reused or redeployed) by multiple other members to facilitate or enable their innovation (Iansiti & Levien, 2004; Nambisan & Sawhney, 2011). In many instances, members may also collaborate more directly and co-develop products and services with other members who have complementary capabilities and other technological assets. As such, an entrepreneur must view other ecosystem members as potential innovation enablers and collaborators. At the same time, members in an ecosystem often compete in similar niche markets offered by the innovation platforms. Further, since all of them operate on the same set of foundational technologies, typically there will be significant overlap in their technological and market knowledge (and the domains of their IP assets). This enhances the potential risk associated with sharing knowledge, technologies, and assets with other members in the ecosystem. Thus, an entrepreneur has to continuously adapt the new venture's approach *vis-à-vis* its partners in the ecosystem so as to optimize the opportunities to collaborate with them but also compete effectively with them both inside the ecosystem and perhaps outside it as well.

Recognizing Innovation and Growth Opportunities. The critical challenge for any type of new venture is survival. For ecosystem entrepreneurs, survival can be seen in two different contexts—survival as a valued member of the ecosystem and survival as a going concern (independent company). To ensure the first type of survival, ecosystem entrepreneurs will need to identify and pursue opportunities within the ecosystem boundaries (internal opportunities) as this allows the new venture to expand on current offerings related to the innovation platform and solidify its position within the ecosystem. To ensure the second type of survival, the ecosystem entrepreneur may need to recognize opportunities outside the ecosystem as doing so allows the company to expand on offerings that are independent of the platform. In particular, there will likely be undue dependencies formed with the foundational technologies and/or a high level of uncertainty with regard to an emerging innovation platform (that is yet to become the dominant design in the market), and as such, most new ventures tend to hedge their bets by simultaneously pursuing opportunities elsewhere.[8] In other words, ecosystem entrepreneurs need to seek out and exploit opportunities both within the market and technological boundaries of the ecosystem as well as outside it. This need for such "entrepreneurial ambidexterity" (Bryant, 2009)—i.e., pursuing exploitation strategy within the ecosystem and exploration strategy beyond it—presents considerable challenge for entrepreneurs, particularly when the new ventures are embedded within specific market and technological frameworks and may suffer from "platform traps" (as we discuss in detail later).

Together, the challenges described earlier—ones that arise directly from the dual roles that the ecosystem entrepreneurs must play—emphasize the flexibility, adaptability, and nimbleness that entrepreneurs must muster to manage their new ventures effectively within innovation ecosystems. We suggest that effective (i.e., well-developed) *self-regulatory processes* on the part of ecosystem entrepreneurs may be especially relevant in this context. We next identify three such processes—ones that have been the subject of extensive research and theory (Vohs & Baumeister, 2011) and which may be especially relevant to the present discussion.

8. A good example of this is the smartphone market where platforms such as Apple's iOS, Google's Android, and Microsoft's Windows Phone are competing to become the dominant design. The risk for new ventures gets accentuated when such platforms are incompatible with one another. At the same time, it should be acknowledged that some new ventures may adopt an explicit strategy of exploiting the opportunity offered by one platform and not desiring (or expecting) to survive beyond the lifetime of that chosen platform.

Self-Regulatory Processes

The self-regulation of behavior has recently become a topic of growing interest in cognitive science as well as in several branches of management (Duckworth & Seligman, 2005; Vazsonyi & Huang, 2010). A large body of evidence indicates that self-regulatory processes play an important and generally beneficial role in the performance of many tasks. Effective self-regulatory processes can help individuals to select appropriate (i.e., achievable) goals, to maintain consistent and persistent focus on these goals, to accurately interpret feedback on their own performance and progress, and to adjust current and future actions so as to maximize such progress. Self-regulatory processes can also assist individuals to accurately assess the effectiveness of various strategies or actions for attaining these goals and to delay gratification in order to increase its later magnitude (Carver & Scheier, 2011; Haynie, Shepherd, Mosakowski, & Earley, 2010). Overall, well-developed self-regulatory processes can greatly assist individuals to choose courses of action or strategies that are appropriate, given their key goals and resources, while avoiding ones that are inconsistent with these goals and resources.

Although well-developed self-regulatory processes are beneficial in a wide range of contexts, they may be especially valuable for ecosystem entrepreneurs. By joining a platform-based innovation ecosystem, entrepreneurs enjoy important advantages that may not be available in other entrepreneurial contexts. Ecosystem entrepreneurs get ready access to an established market (the established customers of the technology platform), to valuable technologies and other innovation assets (developed and distributed by the hub firm), and to potentially beneficial relationships (with other ecosystem members). However, there is an important downside or cost to joining an ecosystem—the partial loss of entrepreneurs' autonomy or independence. Research findings indicate that one important reason why many individuals choose to become entrepreneurs is that they wish to expand their personal autonomy—they want to be the decision makers rather than the implementers of others' decisions and want to choose goals, develop strategies for gaining competitive advantages, and both monitor and evaluate their own performance and progress (e.g., Zhao, Seibert, & Lumpkin, 2010). As members of hub-based innovation ecosystems, however, entrepreneurs experience considerable restriction on such autonomy and personal freedom with respect to operating their companies. For example, as noted previously, they must adhere to policies and pursue goals established by the hub firm.[9] Thus, this context creates conditions calling for high levels of self-regulation. We now describe these conditions in more specific terms.

First, ecosystem entrepreneurs must focus on tasks and goals set by others that they do not prefer to perform while refraining from focusing on goals they would strongly prefer to pursue (i.e., they must demonstrate high levels of self-control, as we discuss later). The special challenges posed by the necessity of restraining and surrendering their own autonomy and independence place ecosystem entrepreneurs in a situation where their self-regulatory skills are especially important and, moreover, are often severely tested.

Second, in addition to performing the wide range of tasks related to running their new ventures successfully, ecosystem entrepreneurs must also successfully perform an additional array of tasks that, in a sense, *overlie* typical entrepreneurial activities and functions—i.e., managing competing roles and relationships. Self-regulatory processes

9. These hub firm-driven restrictions could include choices/decisions related to target market, product features, technology specifications, and product pricing. Such restrictions are often part of the formal membership or license agreements that new ventures sign when they join the ecosystem (and in other cases, they may be part of the informal agreements that new ventures are expected to adhere to).

may be especially crucial in such environments because when functioning at high levels, they enable entrepreneurs to direct their energy, effort, and skills in efficient and effective ways; to select or develop appropriate goals; to alternate between competing goals; to reorder the importance of various goals in response to changing results and environments (Carver & Scheier, 2011); and to deal effectively with tasks and situations that would, in the absence of effective self-regulation, threaten to overwhelm their information processing capacities.

At this point, we pause to note that prior research in entrepreneurship has identified a number of individual-level variables that, together, impact entrepreneurs' (and new ventures') success—for example, self-efficacy, political skills, social skills, resilience and capacity to recover from failure, prior experience, etc. (Baron, 2012). By focusing on self-regulatory processes, we do not in any way imply that other individual skills or characteristics are irrelevant—far from it. However, the context of innovation ecosystem is one in which the importance of self-regulation may be magnified relative to other entrepreneurial contexts. Specifically, in innovation ecosystems, entrepreneurs have a well-defined network of partners (including the hub firm) with whom they interact and share a dependency relationship. In such a context, feedback and self-reflection (concerning the implications of one's decisions and actions) and accurate assessment of progress toward identified goals assume particular importance as a way to adapt to conflicting demands and dependencies.

As noted by Forgas and colleagues (2009), efforts by individuals to regulate their own cognition and actions can be classified as falling into five broad categories. First, they seek to regulate their own thoughts—for instance, toward or away from certain conclusions, or efforts to suppress unwanted thoughts (e.g., ones that interfere with concentration on current problems or tasks). In addition, as noted in more detail later, they also often seek to understand their own cognition (i.e., metacognition)—for instance, to gain insight into what they know and do not know and how this knowledge or experience can best be applied in a particular situation. Second, they seek to regulate their emotions and moods. For instance, they seek to minimize or escape from negative moods and to induce positive ones. Third, individuals often seek to regulate their impulses—which are essentially automatic responses triggered by specific situational cues. Fourth, individuals also seek to regulate their own motivation—for instance, maintaining it at high levels despite major setbacks. Finally, they seek to regulate their actual performance, assuring, for instance, that it meets standards set by others and/or the standards of performance they have set for themselves. In their efforts to regulate these aspects of their own cognition and behavior, individuals employ a wide range of cognitive processes (see Vohs & Baumeister, 2011; Vohs, 2010 for an exhaustive description of such processes). Here, however, we focus on three that have been shown to have both strong and general effects; effects, we suggest, that are directly relevant to the complex environments faced by ecosystem entrepreneurs. These self-regulatory processes are self-control, grit, and metacognition. As explained in more detail later, not only are these important aspects of self-regulation, they are also especially relevant to the ecosystem context on which we focus.

Self-Control

Self-control, a basic and an important aspect of self-regulation, involves resisting powerful impulses to engage in actions believed to be harmful, or at least, inconsistent with major goals (e.g., overeating, speeding, etc.) (Baumeister & Alquist, 2009). It also involves resisting impulses to *stop* performing actions that are not intrinsically enjoyable but are perceived as beneficial or necessary for reaching key goals (e.g., sticking to a diet

or exercise regimen despite strong impulses to stop) (Forgas et al., 2009). A substantial body of research has examined the effects of self-control (Tice, Baumeister, Shmueli, & Muraven, 2007). The findings of this research indicate that individuals differ greatly with respect to this aspect of self-regulation so that some are able to exercise such control across different tasks and over long periods of time while others demonstrate much less capacity to do so (Tangney, Baumeister, & Boone, 2004).

Additional studies indicate that self-control is a depletable resource; after exerting self-control on one task, individuals often demonstrate lower capacity to demonstrate it on another task (Baumeister & Alquist, 2009). Interestingly, positive affect can help to restore such depleted cognitive resources (Tice, 2009). For instance, in one intriguing study on such effects, Tice et al. (2007) found that participants whose positive affect had been elevated by exposure to amusing videos showed significantly stronger self-control than persons whose positive affect had not been enhanced in this manner. These findings support the view that increments in positive affect do indeed replenish cognitive resources essential for exerting self-control (e.g., Baumeister & Alquist), and more generally, that self-control is indeed an exhaustible cognitive resource, but one that can be replenished in various ways. Finally, we should add that recent findings indicate that self-control may also involve a shift from proximal goals to more distal ones (Fujita, 2011).

Given the wide variety of tasks ecosystem entrepreneurs must perform and the fact that they must often work on tasks and goals set by the hub company but of relatively little direct interest to them or their new ventures, it seems possible that they are especially likely to experience self-control depletion because they must exert such self-regulation frequently—more frequently, we suggest, than entrepreneurs who primarily manage their own companies. Thus, it is especially crucial that they be high on this aspect of self-regulation (Tice, 2009).

Grit: Being Focused on and Persistent in Pursuit of Long-Term Goals

Another self-regulatory process that has received increasing attention recently involves two central components: maintaining consistent interest in or focus on clearly defined long-term goals and demonstrating persistence in actual efforts to achieve these goals (Duckworth, Peterson, Matthews, & Kelly, 2007). Together, these two components of self-regulation have been described by the term *grit* (Duckworth et al.). Although these two components are somewhat distinct, they have been combined in recent research (e.g., Duckworth, Kerby, Tsukayuma, Berstein, & Ericsson, 2011; Duckworth & Quinn, 2009) so we treat them as such in the present discussion (i.e., as together reflecting a key process of self-regulation).

Both of these tendencies are related to self-control but are distinct from it in that self-control refers primarily to current actions (e.g., resisting an immediate impulse to behave in ways inconsistent with long-term goals), while these other features of self-regulation refer instead to processes that continue over extended periods of time. For instance, they are reflected in the long-term efforts to achieve the outstanding performance shown by experts in many different fields and may provide a basic foundation of such performance (medicine, science, sports, music, etc.) (Baron & Henry, 2010).

Research evidence indicates that persons high in grit (consistency of focus, persistence of effort) are in fact more successful than those relatively low in many different activities and careers. For instance, they achieve higher levels of education, are more successful in various professions, and more likely to excel in especially rigorous and difficult training programs (e.g., to succeed as cadets at West Point) (Duckworth & Quinn, 2009; Duckworth et al., 2007, 2011). While the capacities to focus consistently

and persistently on efforts to attain long-term goals are clearly relevant to achievement in many different contexts, they may be especially relevant to activities performed by ecosystem entrepreneurs. Ecosystem entrepreneurs, in contrast to many other persons, must keep two distinct sets of only partially overlapping goals clearly in mind and strive actively to attain both. Further, they cannot lose track of long-term objectives relevant to their own companies while pursuing goals and strategies required by hub companies. In such a context, the entrepreneurs' ability to persevere in the new venture's goals without losing track of the ecosystem-oriented goals assumes potential significance.

Metacognition

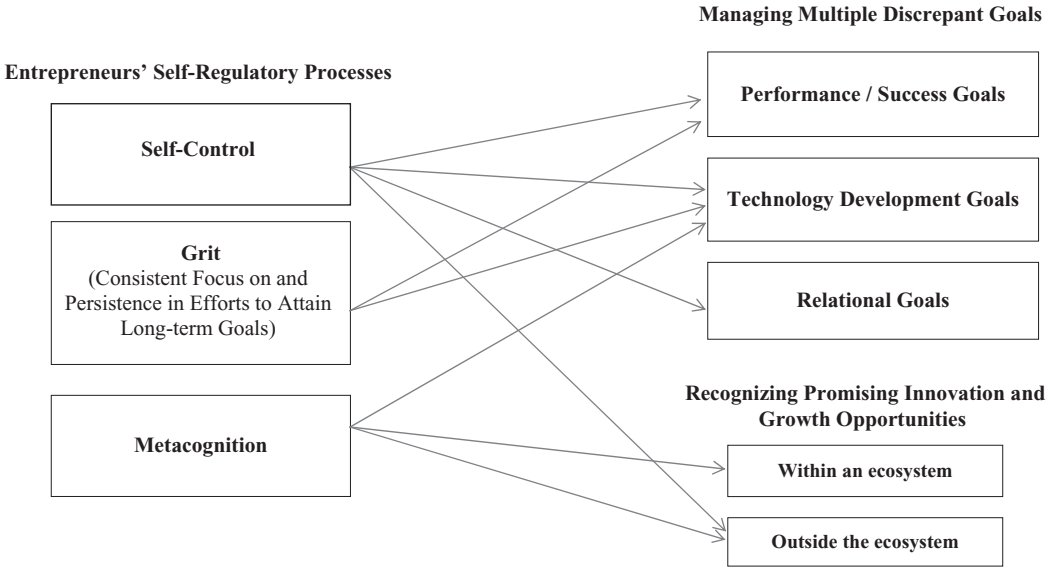
Third, metacognition, which involves individuals' awareness of, and control over, their own cognitive processes (Flavell, 1979)—is also especially relevant to ecosystem entrepreneurs' success. Previous findings indicate that metacognitive processes form the foundation for cognitive adaptation in novel, uncertain environments—the ability to consider alternative cognitive strategies, decision heuristics, frameworks, etc. (e.g., Batha & Carroll, 2007; Melot, 1998; Schraw & Dennison, 1994). Prior studies also indicate that an individual's metacognition is not an unchanging or fixed characteristic; rather, it is an acquired or learned capability that can be enhanced through training (e.g., Schmidt & Ford, 2003). Here, we focus on two specific aspects of such *metacognitive capabilities*—metacognitive awareness and metacognitive resources (knowledge and experience).

Metacognitive awareness refers to awareness of one's own cognitions—what individuals know about themselves as cognitive processors of information. For instance, an individual high in metacognitive awareness might recognize that he or she is not very good at certain kinds of cognitive tasks (e.g., keeping track of many small details) but quite good at other tasks (e.g., recognizing major themes in complex sets of data). Metacognitive resources, in contrast, refer to the knowledge and experience that individuals draw upon in devising or selecting the most effective cognitive strategies to employ in a given situation (Flavell, 1987). Both aspects of metacognition can assist individuals in choosing or developing the most appropriate strategies to employ in performing important tasks involving cognition, for example, solving complex problems or adjusting effectively to rapidly changing environmental conditions.

Recently proposed theoretical frameworks (e.g. Haynie & Shepherd, 2009; Haynie et al., 2010) suggest the significance of both entrepreneurs' metacognitive awareness and metacognitive resources in adopting cognitive strategies that lead to desirable outcomes related to specific entrepreneurial goals. Further, evidence reported recently by Baron, Hmieleski, Fox, and Casper (2011) indicates that one aspect of metacognitive knowledge—knowing when to withdraw from a failing course of actions—has significant effects on the strategies founding entrepreneurs choose for their new ventures. We adapt this reasoning to the context of ecosystem entrepreneurs and suggest that metacognitive capabilities assume particular relevance here given the entrepreneurs' need to make appropriate evaluations of their own capacity to fulfill both the responsibilities established by the hub firm and those pertaining to the continued success of their own venture and to devise adaptive strategies for performing this complex task successfully. In other words, although metacognitive knowledge and awareness are certainly adaptive and beneficial in a wide range of contexts, the special demands faced by ecosystem entrepreneurs may give added weight to understanding their own cognitive strengths and weaknesses and their own array of knowledge and skills. Such knowledge may assist ecosystem entrepreneurs to choose the most appropriate strategies for attaining both goals required by the hub

Figure 1

Entrepreneurs' Self-Regulatory Processes and Success in Managing Dual Roles in Innovation Ecosystems



companies and those relating to their own companies. Metacognition—and especially metacognitive awareness—may also be directly relevant to ecosystem entrepreneurs' efforts to restrain their own desires for autonomy and independence. Being aware of their own powerful motives to obtain such conditions, they may be better able to apply appropriate self-regulatory processes to restrain such motives and to focus instead on meeting the goals and expectations required of them as "good citizens" or members of the ecosystem.

In the following section, we consider in detail how one or more of these self-regulatory processes may enhance ecosystem entrepreneurs' ability to effectively address the three broad sets of challenges identified previously. Figure 1 provides an overview of our research model.

Entrepreneurs' Self-Regulatory Processes and Success in Managing Dual Roles

Managing Multiple Discrepant Goals in Innovation Ecosystems

Ecosystem entrepreneurs must entertain and pursue simultaneously multiple goals—some established by the hub firm and some by the entrepreneur. Further, the environment is often marked by high levels of volatility. This can be due to constant shifts in business models and strategies adopted by the hub firm (which in turn often are in response to changes in market conditions) as well as changes in the underlying technologies themselves. The ability of ecosystem entrepreneurs to constantly shift their focus on, and allocate resources to, the competing goals may be critical.

Research findings on the processes through which individuals navigate between competing goals (e.g., Schmidt, Dolis, & Tolli, 2009) indicate that several variables play a role, including environmental volatility, time remaining until goal deadlines occur, and—perhaps most importantly with respect to the present discussion—dual goal expectancy, the belief that both goals can, in fact, be met. In high-volatility environments, such as the ones ecosystem entrepreneurs face, recent evidence (Schmidt et al.) indicates that individuals initially allocate most time and effort to goals that are farthest from attainment, but then, as time remaining until goal deadlines declines, switch to greater focus on goals that are least discrepant from completion. Further, this shift is strongly mediated by dual goal expectancy. As time remaining to complete specific tasks decreases, dual goal expectancy drops, with the result that focus is switched to the goals most likely to be attained (those least distant from completion).

It is important for ecosystem entrepreneurs to make these shifts between goals effectively because failure to do so could result in negative consequences. For instance, if an ecosystem entrepreneur initially focuses on a goal that is very far from completion—for example, a goal relating to the future development of his or her own company—this may require neglecting goals established by the hub firm. Unless a switch is made back to these goals in a manner that will allow for their completion, the ecosystem entrepreneur may fail to meet goals the hub company considers crucial and so puts his or her place in the ecosystem in jeopardy. In contrast, if an ecosystem entrepreneur initially focuses on goals set by the hub company, he or she may meet these goals but make little progress toward attaining goals crucial for the new venture. It is essential, therefore, for ecosystem entrepreneurs to be able to accurately judge dual goal expectancy, and on the basis of this judgment, to switch between competing goals in a manner that enhances progress toward both.

Previous researchers (e.g., Schmidt et al., 2009) have described the processes involved in switching effort and focus between competing goals as "self-regulatory" in nature (p. 703), and we concur with this assessment. Specifically, we suggest that the self-regulatory processes described previously may play a key role in ecosystem entrepreneurs' capacity to effectively manage competing goals generated by their unique dual roles and relationships in a manner that maximizes outcomes both for their own company and the hub company. We further suggest that the specific aspects of self-regulatory behavior that apply would be dependent on the nature of the competing (i.e., discrepant) goals. Thus, for each of the three types of goals described earlier (success/performance, technology development, relational), we indicate how goal attainment is influenced by self-regulatory processes.

Success/Performance Goals. As noted previously, the success goals and metrics for the new venture and the ecosystem may differ in terms of both scope and time horizon. Such potential conflicts in performance or success goals will demand that the entrepreneur be able to pursue both sets of goals and at the same time shift from one set of goals to another to allocate resources and effort based on specific environmental conditions. And this, in turn, implies the potential relevance of self-regulatory processes, specifically, self-control and grit.

People high in *self-control* may be better able to focus on performing essential tasks and functions, even if they would prefer to perform other activities. In the current context, ecosystem entrepreneurs would generally prefer to work on furthering the interests of their own company (particularly on short-term success goals) but must often defer doing so in order to work on performance goals established by the hub firm since that is more likely to enhance progress toward long-term goals (i.e., delay their

immediate gratifications from pursuing short-term goals). We suggest that higher levels of self-control will assist entrepreneurs in switching between these two sets of success goals as current needs and situations shift and also in maintaining dual goal expectancy since they recognize that they can, indeed, focus on and attain both sets of goals. As prior studies suggest, when dual goal expectancy exists, individuals make better resource allocation decisions to both sets of goals, whereas when such expectancy declines, they tend to abort one goal and focus on achieving another. Thus, when entrepreneurs lack self-control, or when this cognitive resource is depleted, they are likely to make hasty decisions both related to resource allocation as well as pursuing one success goal in preference to another, and thereby minimize the new venture's effectiveness in achieving success both as an independent company as well as an ecosystem member. In other words, they are likely to act impulsively, with all the obvious drawbacks of such actions (e.g., DeYoung, 2010).

Similarly, we also suggest that entrepreneurs' grit (their capacity to maintain consistent focus on or interest in specific long-term goals and to exert persistent effort toward attaining them) would be helpful in maintaining dual goal expectancy over prolonged periods of time and thereby enhance entrepreneurs' success in pursuing multiple discrepant success goals. Both of these elements, i.e., capacity to maintain focus and persistence of effort, would assist entrepreneurs in choosing and striving to meet goals likely to yield the most significant benefits for their companies. This implies focusing on goals set by the hub company when this is perceived to be in the best interests of the entrepreneurs' new venture but shifting to a focus on short-term goals especially useful to the new venture when this strategy is effective. Individuals who are high in this aspect of self-regulation, grit, may be better able to maintain their dual goal expectancy even when one type of goal dominates the other and thus be better able to accomplish such goal switching in an optimal manner. Based on the aforementioned, we offer the following propositions.

> **Proposition 1a:** There is a positive relationship between entrepreneurs' level of *self-control* and their effectiveness in *simultaneously pursuing multiple competing sets of success/performance goals* in the innovation ecosystem.
> **Proposition 1b:** There is a positive relationship between entrepreneurs' level of *grit* (i.e., their capacity to maintain consistent focus on or interest in specific long-term goals and to exert persistent effort toward attaining them) and their effectiveness in *simultaneously pursuing multiple competing success/performance goals* in the innovation ecosystem.

Technology Development Goals. As noted previously, technology development goals and strategies may be set by the hub firm at the level of the ecosystem, and members may be required to adopt such strategies. The new ventures' own goals related to internal technology development may be at variance with those and emphasize the continued external relevance and viability of the company. The need to manage (or maintain) and pursue such dual technological goals for the new venture implies the potential relevance of *self-control*, *grit*, and *metacognition*.

It is important that the entrepreneur is able to persist in investing in both internal technology development efforts as well as ecosystem-driven technological development efforts even when the short-term path to value appropriation (from those efforts) is not clear. In such instances, the entrepreneur's self-control—more specifically, the capacity to limit impulsive actions or refrain from engaging in actions the entrepreneurs would prefer to perform but do not advance goal attainment—will prove to be very beneficial

in ensuring the new venture's success. Further, some of the technological changes imposed by the hub firm may be devised so as to enhance the technological maturity of the platform rather than the value added by the new ventures' offerings (e.g., changes related to platform interface specifications). In such instances, entrepreneurs may need to sustain their efforts in pursuing those hub firm-driven technological changes even if they would rather prefer not to do them (given that the returns from such efforts are likely to be delayed and more long term in nature), and this again enhances the importance of self-control (Baumeister, Heatherton, & Tice, 1994). This is also consistent with the recently developed perspective (Fujita, 2011) that views self-control not merely as the capacity to inhibit impulses that are inconsistent with key goals but also as the shifting of one's focus from proximal (immediate) to more distal goals.

As new technologies and technological changes are introduced by the hub firm, this may disrupt the new venture's internal technological development efforts. Often, such technological changes demand that the new venture expend additional resources to ensure that their products/services continue to comply with the new technological specifications. At such times, the entrepreneur's ability to allocate appropriate levels of resources so as to consistently pursue the internal technological goals will be equally important. Higher levels of skills associated with grit would enable the entrepreneur to not only maintain a high level of dual goal expectancy when sudden disruptions occur (due to technological changes in the ecosystem) but also help in making more judicious decisions related to resource allocation.

Finally, we also suggest that an entrepreneur's metacognitive capabilities would facilitate better decision making and choices related to competing technology development goals. Specifically, when changes in the technological environment dictated by the hub firm intensify (for instance, a new technology development goal), these changes and increased demands tend to heighten the entrepreneurs' metacognitive awareness (Haynie et al., 2010) since they must now deploy their metacognitive resources, both knowledge and experience, in order to formulate adaptive strategies for meeting these new demands. This might involve, for instance, drawing on metacognitive knowledge related to their own understanding of "what they know and don't know," i.e., "knowing" the relative strengths and weaknesses of their own (or company's) technological capabilities. This, in turn, may help ecosystem entrepreneurs to develop a deeper understanding of the resources required for incorporating the technological change or the extent of overlap with ongoing internal R&D efforts. Such metacognitive knowledge can then help entrepreneurs to make better judgments as concerning the extent to which the new technological trajectory (dictated by the hub firm) departs from the new venture's own existing technological trajectory and what implications this holds with regard to their existing technological or R&D strengths and weaknesses. Further, such metacognitive knowledge and experience may also strengthen entrepreneurs' understanding of the importance of that technological change for the hub firm and/or how such a change will likely be adopted by other ecosystem members. Recognizing the importance of these technological changes for the hub firm may help ecosystem entrepreneurs to deploy self-regulatory processes as needed to assure that these new demands from the hub firm are placed at an appropriate position in the hierarchy of current goals. Thus, together, these aspects of metacognitive capabilities can assist entrepreneurs in developing appropriate strategies for adapting to the hub firm's new technological requirements and goals and managing the potential conflicts among the different technology development goals (ecosystem-based goals and new venture's internal goals). Based on the previous discussion, we offer the following three propositions.

Proposition 2a: There is a positive relationship between entrepreneurs' level of *self-control* and their effectiveness in *simultaneously pursuing multiple competing technology development goals* in the innovation ecosystem.

Proposition 2b: There is a positive relationship between entrepreneurs' level of *grit* (i.e., their capacity to maintain consistent focus on or interest in specific long-term goals and to exert persistent effort toward attaining them) and their effectiveness in *simultaneously pursuing multiple competing technology development goals* in the innovation ecosystem.

Proposition 2c: There is a positive relationship between entrepreneurs' *meta-cognitive capabilities* and their effectiveness in *simultaneously pursuing multiple competing technology development goals* in the innovation ecosystem.

Relational Goals. The potential for new ventures to derive benefits from ecosystem membership is many, particularly with regard to their relationship with other members. As noted previously, this includes the opportunity to leverage other members' innovation assets as well as the opportunity to pursue collaborative innovation with peer members. However, in doing all this, an ecosystem entrepreneur has to ensure that the new venture maintains good relations with other ecosystem members. This may involve restraining impulses to take advantage of knowledge gained through the ecosystem—knowledge that the entrepreneur might exploit to advance the interests of their own company, but at the expense of other member firms. Given that many ecosystem members may be competitors in relevant markets, entrepreneurs' ability to maintain a balance in their relationship by refraining from actions that use knowledge acquired in the network to gain competitive advantage over other ecosystem partners assumes importance. We suggest that in this context, the entrepreneur's *self-control* is directly relevant.

Entrepreneurs' ability to *refrain from engaging in impulsive actions* (i.e., which derives, at least in part, from self-control) assumes considerable importance in this context. This is particularly relevant when members operating in same or similar markets collaborate or leverage one another's knowledge or other intellectual property assets. In such instances, the entrepreneur's self-control is directly related to the new venture's ability to refrain from exploiting a short-term advantage *vis-à-vis* a partner (say, in terms of shared knowledge or IP), while keeping in view the longer term relationship with the partner and the new venture's continued membership in the ecosystem (the aspect of self-control emphasized recently by Fujita, 2011). In short, higher levels of self-control would help an entrepreneur to minimize the potential for a new venture's role as competitor encroaching upon its role as collaborator (or vice versa) in the ecosystem. Thus, based on the previous discussion, we suggest the following.

Proposition 3: There is a positive relationship between entrepreneurs' level of *self-control* and their effectiveness in *simultaneously pursuing multiple competing relational goals* (i.e., as collaborator and competitor) in the innovation ecosystem

Recognizing Innovation and Growth Opportunities Within the Ecosystem and Beyond

Within an Ecosystem. Ecosystem entrepreneurs are likely to find numerous opportunities to innovate and grow within an ecosystem (e.g., opportunities to expand into new market

spaces, develop new offerings on the platform, collaborate with other members, etc.). While such opportunities may abound, it is critical for the entrepreneur to identify and pursue only those that are most suitable and beneficial for the new venture. We suggest that entrepreneurs' metacognitive capabilities assume importance in shaping their ability to identify relevant opportunities within the ecosystem for innovation and growth—in a sense, in their ability to distinguish between potentially valuable opportunities and "false alarms" that will waste their time and effort with little chance of beneficial returns (e.g., Baron, 2002).

As the hub firm adapts to external environments, it makes both incremental and radical changes in its business model and innovation platform, which, in turn, may create new opportunities for the ecosystem members to exploit as well as reduce the appeal of existing market spaces. As the novelty and dynamism associated with these opportunities increase, the entrepreneurs' metacognitive awareness will also be heightened (Haynie et al., 2010). Such awareness will direct attention to the cognitive frameworks employed to identify and evaluate the emerging and new opportunities. As noted previously, entrepreneurs' metacognitive resources (knowledge and experience) will be critical in informing the entrepreneur as to the most effective cognitive frameworks and strategies to deploy in this regard. For example, entrepreneurs' understanding of the technological and/or market capabilities associated with an opportunity (*vis-à-vis* the ventures' past experiences with developing such capabilities), their assumptions related to technological, market, and operational risks that underlie such typical opportunities in the ecosystem, and their intuitions related to the nature of likely competition in the new market space or the potential for the hub firm to encroach upon this market space in the future, etc. may help the entrepreneur to devise the most appropriate cognitive responses and strategies to such new opportunities and choices within the ecosystem. In short, we suggest that higher levels of metacognitive capabilities—both awareness and knowledge/experience—will enhance the entrepreneurs' success in opportunity recognition within the ecosystem. Thus, we offer the following proposition.

> **Proposition 4:** There is a positive relationship between entrepreneurs' *metacognitive capabilities* (awareness and knowledge/experience) and their effectiveness in *recognizing promising innovation and growth opportunities within the innovation ecosystem*.

Outside the Ecosystem. Ecosystem entrepreneurs need to be able to recognize (and exploit) opportunities not just within the ecosystem but also outside it. Typically, once a new venture joins an ecosystem, the potential for the entrepreneur to get trapped into the ecosystem's "technological and market assumptions and outlook" increases (i.e., "platform trap") (Gawer & Cusumano, 2002) and could potentially prevent them from discovering new opportunities outside the ecosystem (that may go against those assumptions). This may occur because the entrepreneur's perceptual focus is narrowed by constraints (e.g., frameworks, goals) established by the hub company. Self-regulatory mechanisms, specifically self-control and metacognition, may help entrepreneurs avoid or overcome this especially damaging "platform trap."

Opportunity recognition has been described in current literature as a process of scanning the environment and searching for patterns suggestive of business opportunities (e.g., Baron, 2006; Tang, Kacmar, & Busenitz, 2012). More recently, drawing on the structural alignment concept (Gentner, 1989), Gregoire, Barr, and Shepherd (2010) conceptualized opportunity recognition as the cognitive process of finding

similarities between the superficial features and structural relationships of a new stimulus (opportunity) with those of a relevant source (e.g., information previously stored in memory). Such a conceptualization facilitates a deeper understanding of the ecosystem entrepreneurs' success in identifying opportunities outside the ecosystem. Specifically, research findings suggest that comparison of superficial features (e.g., characteristics of a new technology, size of a new market space, number of production processes involved, etc.) takes less cognitive effort compared with the comparison of structural relationships, which involve higher order relationships (e.g., potential impact of a new material on production process or on product function, the potential rate of growth of a new market, etc.). Since comparison of superficial features is largely done by drawing on one's own memory and prior experiences (Gentner; Gentner, Rattermann, & Forbus, 1993), it poses less cognitive load but at the same time is limited to a narrower search space (e.g., set of domains with which the entrepreneur has dealt) (Keane, Ledgeway, & Duff, 1994) and as such, does not help overcome the platform trap (or cognitive trap) associated with the ecosystem. On the other hand, comparison of structural relationships will involve higher order reasoning processes (i.e., greater cognitive load) but at the same time offers more valuable interpretation of a new opportunity (particularly when such an opportunity involves considerable level of uncertainty).

We suggest that entrepreneurs' *self-control*, specifically their ability to resist impulses to *stop* performing actions that are not intrinsically enjoyable (Baumeister et al., 1994; Forgas et al., 2009), will enhance entrepreneurs' willingness to pay more attention to aligning structural relationships than to aligning superficial features. In other words, they will be more willing or capable of investing the high levels of cognitive effort to perform such tasks. This becomes more crucial in the ecosystem context since the entrepreneurs are attempting to recognize opportunities outside the ecosystem (exploration) wherein the temptation to stop such efforts and pursue opportunities within the ecosystem (exploitation) is likely to be high.

We also suggest that entrepreneurs' *metacognitive capabilities* will enhance their ability to align structural relationships and thereby enhance their success in opportunity recognition outside the ecosystem. Specifically, awareness of one's cognitive processes and the associated metacognitive knowledge and experience enables the entrepreneur to acknowledge the cognitive traps associated with the ecosystem and to adopt more abstract and richer mental representations or frameworks in interpreting the signals regarding the new opportunity. Prior studies suggest that such abstract and deeper level knowledge and mental representation are critical for the comparison and the alignment of structural relationships associated with an opportunity with those of a relevant context (Gregoire et al., 2010). Further, this assumes greater importance in those contexts where there is limited similarity at the level of superficial features, which is typical of opportunities outside the ecosystem. Based on the previous discussion we offer the following propositions.

Proposition 5a: There is a positive relationship between entrepreneurs' level of *self-control* and their effectiveness in *recognizing promising innovation and growth opportunities outside the innovation ecosystem*.

Proposition 5b: There is a positive relationship between entrepreneurs' *metacognitive capabilities* (awareness and knowledge/experience) and their effectiveness in *recognizing promising innovation and growth opportunities outside the innovation ecosystem*.

Discussion and Implications for Future Research

In this paper, we have viewed entrepreneurs' success in innovation ecosystems from the perspective of self-regulatory processes and advanced a set of related propositions. By doing so, we seek to make several key contributions to ongoing research and emerging theory.

As noted previously, prior research has identified the relevance of self-regulatory processes in entrepreneurship, although much of the focus has been on understanding in what ways self-regulation can contribute to entrepreneurial activities in general—for instance, to effective opportunity recognition or creation, development of "entrepreneurial expertise" or an entrepreneurial mindset (e.g., Baron & Henry, 2010; Haynie & Shepherd, 2009; Mitchell, 1994; Mitchell et al., 2007). In this paper, we extend current theory in this regard by identifying and discussing the contextual characteristics—specifically, strong dependencies, common or overlapping goals, and shared capabilities—that influence the importance and impact of self-regulation in one particular, and increasingly important entrepreneurial setting—innovation ecosystems. A focus on the underlying features of the entrepreneurship context facilitates the development of a richer understanding of *why* (and under what circumstances) self-regulatory processes enhance entrepreneurs' success. Such an approach also helps us to apply sound theoretical reasoning (e.g., dual goal expectancy theory) to explain the relationship between self-regulation and entrepreneurial success.

Although the present discussion has focused on the self-regulatory processes of ecosystem entrepreneurs, the same mechanisms may play an important role in other entrepreneurial contexts in which similar conditions exist. For example, here we suggested that self-regulatory mechanisms assume special significance in contexts where entrepreneurs must make choices and allocate limited resources and effort in the presence of conflicting sets of goals and external forces. Such characteristics may apply (albeit to a lesser extent) to other types of innovation ecosystems. For example, in open source communities, entrepreneurs (and new ventures) pursue common goals and share capabilities with other ecosystem members, although instead of an all-powerful hub firm, the governance is more distributed, and as such, dependencies tend to be more evenly distributed among all the members. Beyond the context of innovation ecosystems, such situations may arise for new ventures in other partnership contexts too (albeit to different extents)—for example, in operations-focused business ecosystems (e.g., Wal-Mart's supplier ecosystem), collaboration or dyadic partnerships with other companies (e.g., strategic alliances and joint ventures), participation in industry standard-setting committees and R&D consortiums, etc.

The theoretical arguments developed here may potentially inform future efforts to understand how entrepreneurs' self-regulatory processes influence their success in these varied contexts, too, and may contribute significantly to emerging theory in the field of entrepreneurship in this manner. Further, following this line of thought, our discussion also indicates the promise of identifying additional contextual characteristics that may accentuate the role of self-regulatory processes in entrepreneurship. The broader implication then is to develop a theory of self-regulation in entrepreneurial contexts that considers the complex interplay between micro-level processes (e.g., the self-regulation processes themselves) and important contextual or environmental factors. This multilevel approach has been recommended by many researchers (e.g., Baron, 2007; Hitt, Beamish, Jackson, & Mathieu, 2007) and is viewed by many within the field as a key requirement for continued informative progress.

Our framework also contributes to a deeper theoretical understanding of the nature of the adaptations that entrepreneurs must make and the associated skills they need to attain success in innovation ecosystems. A new venture may enter and participate in an innovation ecosystem based on the unique collective expertise of its founders (technological, marketing, etc.) in a niche area. However, it is really the entrepreneur's ability to adapt the venture's strategies and practices so as to simultaneously achieve the dual objectives of keeping it well-aligned with the innovation ecosystem as well as retaining and enhancing its viability in the broader market that will determine the new venture's long-term success. Our framework offers added theoretical clarity with respect to the challenges associated with these dual roles—specifically, the tasks related to managing multiple discrepant goals and recognizing diverse opportunities both within and the outside the ecosystem—and thereby to the task of understanding key determinants of success among ecosystem entrepreneurs. Importantly, our framework also focuses attention on entrepreneur's self-regulatory processes in order to identify the skills that would be needed to meet the aforementioned challenges.

As discussed earlier, the close attention to feedback and high levels of self-reflection that underlie self-regulatory processes enable individuals to adapt to conflicting demands and dependencies, and as such, self-regulation forms a particularly appropriate theoretical lens through which to evaluate entrepreneurs' success in managing the dual roles in innovation ecosystems. In addition, and importantly, several aspects of self-regulation may assist entrepreneurs to deal effectively with the restrictions on autonomy and independence that are inherent in membership in an innovation ecosystem. We believe the central theme articulated by our framework—i.e., the requirement that entrepreneurs play dual roles in the innovation ecosystem and the cognitive strategies and practices they use to effectively deal with these sometimes competing, role-generated demands—can serve as a foundation for new theory building in the emerging area of *ecosystem entrepreneurship*.

The three self-regulation processes considered here suggest several interesting directions for future research. For example, our focus on managing multiple discrepant goals highlights the critical role that entrepreneurs' skills related to self-control and grit can play in the timely channeling of the new venture's resources and efforts. As new ventures participate in innovation ecosystems, they are likely to be literally flooded with opportunities and constraints from several directions—from the hub firm, from the external market, from the ecosystem members, from the venture capitalist who funded the new venture, etc. Future research may consider additional self-regulatory processes that would enhance the entrepreneurs' ability to successfully navigate the associated potentially discrepant set of goals—for instance, the capacity to exercise what is known as attentional control—directing interest or concentration to those aspects of a situation that are, in fact, most crucial in it and to an individual's level of performance (Rueda, Posner, & Rothbart, 2010).

Another promising research direction would be to investigate innovation ecosystems from other theoretical perspectives. For example, in the strategic management literature, the concept of dynamic capabilities reflects the firm's ability to appropriately adapt, integrate, and reconfigure internal and external organizational resources and competences to match dynamic environmental demands (Teece, 2009; Teece, Pisano, & Shuen, 1997). Given that self-regulation relates closely to the entrepreneurs' (new ventures') ability to navigate multiple discrepant goals in a dynamic environment, it seems possible that these two concepts are related to one another and form an interesting issue for future research. For example, do entrepreneurs' self-regulatory skills contribute to building such dynamic capabilities in their new ventures? Finally, if self-control and perhaps other self-regulatory

processes are indeed limited and depletable cognitive resources (e.g., Baumeister & Alquist, 2009), further research should investigate various techniques for strengthening or restoring such resources.

The notion of entrepreneurial ambidexterity (Bryant, 2009) assumes great significance in the context of innovation ecosystems given the need to exploit the opportunities within the ecosystem (thereby maximizing the benefits from ecosystem membership) and to explore the opportunities beyond the ecosystem (thereby managing the dependency on the ecosystem). Here, we focused primarily on the potential impact of the entrepreneurs' metacognitive capabilities in recognizing opportunities within and outside the ecosystem. However, other self-regulatory processes and skills not considered in detail may also play a role. For example, the capacity to regulate emotions or affect (e.g., Gross, 2001) may be relevant. Recent research (e.g., Baron, Tang, & Hmieleski, 2011) suggests that entrepreneurs may benefit greatly from effective regulation of their high levels of optimism and positive affect because high levels of positive affect can reduce attention to negative information—input that is often essential to making accurate or effective decisions. Thus, the capacity to regulate their own emotions can be very beneficial to entrepreneurs and perhaps especially to ecosystem entrepreneurs whose efforts to simultaneously pursue opportunities within and outside the ecosystem and resolve the associated conflicting goals may foster strong emotional reactions.

Based on upper echelons theory, we made the connection between entrepreneurs' self-regulatory processes and a new venture's success (in navigating multiple discrepant goals, identifying/pursuing external/internal opportunities, etc.). It is also very likely that such self-regulatory processes could have significant impact on individual level outcomes—for example, entrepreneurs' life satisfaction and perceived stress and even personal health (e.g., Shepherd, 2004). Future empirical work should examine the potential impact of entrepreneurs' self-regulatory processes on these individual outcomes and processes.

Future research should examine the possibility that with respect to self-regulation, as with almost any other complex cognitive or behavioral process (Grant & Schwartz, 2011), there can be "too much of a good thing." In other words, although various aspects of self-regulation can often yield beneficial effects, improving both individual and perhaps team performance (e.g., through increased coordination) up to a determinable point, but beyond this level point, further increments in the strength or application of self-regulation may actually yield detrimental effects. For instance, strong proclivities to stay focused on specific goals may lead individuals to overlook other opportunities or possibilities that emerge from changing environmental conditions (i.e., shifts in technology, competition, etc.).

In addition, the more general issue of complex, reciprocal relationships between distinct self-regulatory processes should also be examined. Self-regulatory processes do not typically function in isolation; rather, they tend to interact in complex and often reciprocal ways. For instance, certain aspects of metacognition (e.g., knowing when to withdraw from failing courses of action) may assist individuals to avoid the detrimental effects stemming from very high levels of persistence described earlier. Regardless of the precise nature of such interactions and the specific self-regulatory processes involved, they seem well worthy of future research attention.

The propositions advanced in this paper lend themselves to empirical testing. Validated scales and other (e.g., behavioral) measures exist for all of the self-regulatory constructs considered, and these measures may be readily adapted for empirical research in the innovation ecosystem context. Our focus on new ventures' success in innovation ecosystems implies two broad sets of dependent variables—variables related to their

successful membership in the ecosystem (e.g., tenure, relationship with hub firm, number of alliances with ecosystem members, etc.) and those related to their individual performance (e.g., growth in sales/profits, number of offerings, etc.).

Finally, at a broader level, we seek to call the attention of researchers in several fields (e.g., organizational behavior, strategy, technology management, etc.) to the importance of innovation ecosystems as a rapidly expanding context for entrepreneurship, one to which prior research—in innovation management and entrepreneurship—has directed limited attention. While our particular focus on entrepreneurs' self-regulatory processes may be only one of the research avenues, we believe the broader theoretical themes outlined earlier pose several interesting issues for research. For example, what are the characteristics of a new venture's technology/R&D strategy that would enable it to leverage common innovation assets in the ecosystem without enhancing its ecosystem dependencies? And how do the characteristics of the innovation platform (say, modularity) shape a new venture's ability to simultaneously collaborate and compete with other ecosystem members?

Managerial Implications

Our model suggests a key implication for managerial practice. Entrepreneurs planning to participate in innovation ecosystems should recognize the additional constraints and dependencies that would govern their actions and decisions in that context. Entrepreneurs who are accustomed to taking independent action in their own new ventures may find it difficult to comply with the rules and policies set forth by the hub firm in the ecosystem. A key message for entrepreneurs, then, is this: If they choose to enter such environments, they will need specific skills and capabilities, and perhaps a greater than typical level of metacognitive awareness, in order to survive and prosper.

Entrepreneurs contemplating entry into an innovation ecosystem, therefore, should consider carefully the extent to which their skills and predispositions fit the special demands of this environment. In other words, they should reflect on the important issue of person–environment fit (see Edwards, 2008, for a review) as it applies to entrepreneurship generally (e.g., Markman & Baron, 2003) and, in particular, to the requirements for effective performance in innovation ecosystems—i.e., how their personal skills related to self-regulation are congruent with the demands of the innovation ecosystem. Since the importance of some of these skills may be less prominent in general entrepreneurship contexts, many entrepreneurs who have found success in other contexts may pursue initiatives within an innovation ecosystem only to belatedly discover that they lack the skills to perform well in this new context.

It should be noted, however, that all of the self-regulatory processes discussed here are ones that can be acquired or strengthened (Forgas et al., 2009). A growing body of research evidence has identified several techniques that are effective in strengthening or eliciting such processes. These include simple priming procedures in which individuals are reminded of key goals they wish to reach (Papies & Hamstra, 2010), mental contrasting (which requires individuals to think about their goals, outcomes, and obstacles), and implementation intentions (which involve individuals to think about how they will actually implement their goals) (Stadler, Oettingen, & Gollwitzer, 2010).

Conclusion

With innovation ecosystems assuming greater significance as a venue for entrepreneurship, it has become imperative that we develop a deeper understanding of the

associated opportunities and constraints they afford and also of the skills that entrepreneurs need to survive and thrive in these dynamic environments. In this paper, we have tried to facilitate such an understanding by calling attention to the potential role of several aspects of entrepreneurs' self-regulatory processes to their success in innovation ecosystems. By investigating the effects of these and other variables and processes, future research may provide important insights into the nature and outcomes of entrepreneurship in what is rapidly becoming an important new context for its occurrence.

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