ENTREPRENEURSHIP IN DIGITAL PLATFORMS: A NETWORK CENTRIC VIEW

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Research Summary

Research on entrepreneurship has primarily focused on the individual characteristics of founders in driving the success of new ventures offering standalone products and/or services. In recent years, we have seen an increase in entrepreneurship in digital platforms—where success requires positioning products and services within dynamic digital networks that depict complex connections among platforms, complementary modules and consumers. This paper introduces...
key elements of a theory for settings where entrepreneurship success is intricately connected to the moves of other entrepreneurs and coordinated within- and across- platforms. We introduce a network centric view to understand how entrepreneurs occupying the role of third-party developers support digital platforms by their choices to link to them. Furthermore, we develop propositions reflecting a dynamic perspective representing two key stages of competition in digital platforms, initial launch and scale-up. We hope that this work guides further theorizing and empirical research in digital platforms and entrepreneurship in general.

Managerial Summary

Over the last decade, we have seen a rise in digital entrepreneurs that support platforms such as Apple iOS, Google’s Android, Facebook, Twitter, and others. The success of platforms requires support from applications, and entrepreneurs in such settings play a critical role in making some platforms succeed relative to others. Our study provides insight into how digital entrepreneurs can orchestrate strategic moves that allow them to navigate the complex landscape of linking and adapting to different platforms and how these linkage choices can lead to entrepreneurial success.
INTRODUCTION

Considerable academic interest has focused on the entrepreneurial process - specifically the
discovery and exploitation of entrepreneurial opportunities, the role of key individuals involved
in driving the entrepreneurial process and ultimately the success of new ventures (Gartner, 1988;
Low and MacMillan, 1988; Shane and Venkatraman, 2000). Studies have focused on the role of
the behavioral and cognitive characteristics of the founders and/or founding teams in identifying
entrepreneurial opportunities and creating new ventures (for instance, Markman, Balkin and
Baron, 2002; Mitchell et al., 2007; Baron, 2007; Dyer, Gregersen and Christensen, 2008;
Slepstov and Anand, 2009; Cassar and Friedman, 2009; Brinckmann and Hoegl, 2011). Other
studies have gone further to understand how founder attributes ultimately lead to the success or
failure of their key ventures. For instance, performance of new ventures has been linked to prior
experience and ability to acquire cognitive resources (Baron and Henry, 2010; Boeker and
Fleming, 2010); individual knowledge and skills (Hitt et al., 2011); improvisational behavior of
entrepreneurs (Hmieleski, Corbett and Baron, 2013); entrepreneurial orientation (Wales et al.,
2013); networking ability of entrepreneurs (Semrau and Sigmund, 2012); and the self-efficacy of
lead founders (Hmieleski and Baron, 2008). This line of work assumed that an individual
entrepreneurial company succeeds solely based on its firm-specific capabilities.

More recently, there has been a growing call to adopt the social network perspective as an
analytical lens for understanding strategic actions and performance of entrepreneurs (e.g., Stuart
and Sorenson, 2007) and some have focused on the role of the entrepreneurial actor’s network in
driving opportunity recognition (for example, Elfring and Hulsink, 2003; Stuart and Ding, 2006)
and resource mobilization (for instance, Higgins and Gulati, 2003; Robinson and Stuart, 2007;
Shalley and Perry-Smith, 2008).
Such a network perspective, however, has been limited to social linkages and does not recognize digital platforms as settings that call for understanding entrepreneurship in the presence of complementary products (Katz and Shapiro, 1994; Schilling, 2003) with key resources obtained from ecosystem partners. Windows in personal computers and iPhone and Android in smartphones represent such digital platforms. Entrepreneurs, who developed complementary software, have played key roles in the successful dominance of Microsoft’s Windows operating system (Bresnahan and Greenstein, 1999) in the personal computers (PCs) during the 1990s and more recently for Apple’s and Google’s success with iPhone and Android respectively. Such entrepreneurship requires continually adapting choices to current and new platforms under dynamic shifts of technical and business architectures (Baldwin and Clark, 1997) without formal mechanisms of long-term contracts or equity investments (Gawer and Cusumano, 2002; Venkatraman and Lee, 2004).

Our goal in this paper is to adopt the network perspective to theorize about entrepreneurial success in digital platforms. We draw on extant research on networks and platform-based competition to explain how a digital entrepreneur’s choice of linkage in two types of networks – resource (Barabasi, 2002; Powell et al., 2005; Venkatraman and Lee, 2004) and module networks (Arthur, 1989; Shapiro and Varian, 1998; Katz and Shapiro, 1994; Eisenman, Parker and Van Alstyne, 2006) – determines their likelihood of success. Resource networks describe the networks of relationships that digital entrepreneurs use to gain financial and human capital. Module networks refer to the networks of relationships that digital entrepreneurs form with the platform firms that they choose to support. We, further, expand our understanding of entrepreneurship in digital platforms by adopting a dynamic perspective that
recognizes that the linkage choices in each of these types of networks varies at the different stages of start-up and scale up.

The rest of our paper is organized as follows: Our next section describes the role of entrepreneurship in digital platforms. Specifically, we describe the digital platform setting and draw on current research on entrepreneurship and platform-based competition to describe the types of networks that digital entrepreneurs are part of. We then offer a set of propositions on how entrepreneurial success in these settings can be obtained through the linkage decisions of digital entrepreneurs in their resource and module networks. We conclude by discussing the implications of our study for research on platforms in particular and entrepreneurship in general.

ENTREPREUNRSHIP IN DIGITAL PLATFORMS: TWO STRANDS OF INFLUENCE

Digital platforms have proliferated as engines of innovation for other firms to build complementary products and services (Gawer, 2009) in ecosystems as diverse as PCs, video games, and smartphones to newer webs orchestrated by Facebook, YouTube, Twitter and others. Success of such digital platforms rely on important roles of complementary innovators (Boudreau and Lakhani, 2009). Without entrepreneurs who developed and adapted their applications to the successive evolution of iPhones hardware and software, Apple’s revival would have been less dramatic. Yet, most attention has focused on platform winners such as Apple rather than on those entrepreneurs—whose choices in supporting different platforms intricately have contributed to success of digital platforms.

Our focus is on entrepreneurs in digital platforms. We begin by building upon prior research on entrepreneurship that has highlighted the important role of financial and human talent resources and how entrepreneurs strategically gain access to them. We specifically theorize on how entrepreneurs in digital platforms must focus on obtaining financial capital from
high-status venture capitalists to achieve entrepreneurial success. We define the relationships that
digital entrepreneurs form with venture capitalists to access important financial and human
resources as their resource networks. We, then, focus on theorizing about how entrepreneurial
actions in these settings depend upon coordination with platform firms and responding to actions
of competitors. The choices that digital entrepreneurs make are around which platforms to
support with specific application or module launches. We, thus, define their relationships with
platform firms as their module network. Moreover, since such actions are time-varying given the
evolutionary shifts in platform architecture, we adopt a dynamic perspective that recognizes that
different strategic moves during the stages of launch and scale up might lead to entrepreneurial
success.

Resource Networks of Digital Entrepreneurs

Important activities for any entrepreneur include functions as diverse as market research,
technology development and testing, growing the management team and building legitimacy
with multiple stakeholder groups (Chrisman & McMullan, 2000; Rice, 2002; Choi and Shepherd,
2004). As a result, the relationships and network connections that entrepreneurial firms form
with other organizations and partners can serve as pathways through which they can access
resources and opportunities (Hite, 2005). Entrepreneurs, in addition, rely on their networks for
information, advice and for signaling reputation (Hoang and Antoncic, 2003). Prior studies have
focused on the diverse resource networks of entrepreneurs such as their personal social networks
(Batjargal, 2003; Stuart and Ding, 2006), alliance networks (Stuart et al., 1999; Robinson and
Stuart, 2008) and venture capital networks (Shane and Stuart, 2002). These studies have
primarily focused on how an entrepreneur’s position in these networks determines
entrepreneurial success.

Over time, entrepreneurial firms have become increasingly reliant on venture capital firms for funding and helping them develop their resource base. A wealth of anecdotal evidence points out that relationship capital matters in Silicon Valley. From an entrepreneurial perspective, relationship capital facilitates the discovery of opportunities, as well as mobilization of scarce resources (Birley, 1985; Greene and Brown, 1997; Uzzi, 1999). In Silicon Valley, the networks that entrepreneurs establish with a multitude of institutions are critical and distinguishing features of success. These networks have had special importance in the movement of labor, the evolution of influence and power, and the actual production of innovation (Saxenian, 1994; Castilla et al., 2000). Relationship capital is key to initial venture capital funding that is critical for mobilizing human talent and subsequent financial capital for scale-up and growth.

A large body of research has attempted to understand how entrepreneurs secure funding for their new ventures (for instance, Aldrich and Auster, 1986; Stuart, Hoang, and Hybels, 1999; Shane and Stuart, 2002; Stuart and Sorenson, 2007) by focusing on entrepreneurs’ network connections to access venture capitalists. Podolny (2001) developed the idea that an actor’s social status serves as a signal of its quality. The ties that entrepreneurs form ‘serve as information cues on which others make inferences about the underlying quality’ of focal firms. Signals such as an organization’s status (Podolny, 1994; Chung, Singh, and Lee, 2000), the connections of an organization’s top management team and board members (Higgins and Gulati, 2003), and an organization’s winning of awards (Rao, 1994) all allow potential partners to infer the quality of an organization and its resources.

This idea has been tested in the entrepreneurship literature given the great deal of
uncertainty associated with a new venture (Stinchcombe, 1965; Aldrich and Auster, 1986; Stuart and Sorenson, 2007). The uncertainty surrounding new ventures makes it hard for resource providers such as VC firms to assess their quality (Stuart et al., 1999). As a result, firms with high-status founders, employees, or partners are likely to be at an advantage in the competition for resources, and, therefore, attract more financing (Stuart and Sorenson, 2007).

Prior research has also found the value for entrepreneurs in sharing social network connections with investors. When investors and entrepreneurs share network connections, it becomes easier for investors to access and discover information with respect to an entrepreneur’s capabilities and reliability (Stuart and Sorenson, 2007). Specifically, studies have found that venture capitalists prefer to invest in entrepreneurial ventures they learn of through referrals by close contacts, including entrepreneurs they have previously sponsored, fellow venture capitalists, family members, and other professional contacts (Fried and Hisrich, 1994; Shane and Stuart, 2002).

In digital platforms, where the pace of change of technology is rapid and the intensity of competition is very high, the ability to differentiate one’s offerings and rapidly adapt to technological change is critical for success and survival. For new entrepreneurial developers, in particular, a key challenge is to be able to develop and access resources to rapidly navigate technological change and support multiple platforms simultaneously over time. As such, a key source of developing those resources required for scale-up and growth is access to venture capital funding. While relationships with venture capital firms provide the necessary financial resources to succeed in dynamic platform settings, they also provide the advantage of increased legitimacy for the digital entrepreneur in a hyper-competitive environment allowing them to attract better talent and make their offerings more attractive for the end customer.
Module Networks of Digital Entrepreneurs

In settings where technology advances rapidly, there is a greater desire for flexibility from both consumers and producers to respond to the changing heterogeneity in inputs and demands, making modular systems very attractive (Schilling, 2000). Systems that were originally tightly integrated may be disaggregated into loosely coupled components that can be mixed and matched, allowing much greater flexibility in end configurations. For instance, the personal computer industry has evolved from being stand-alone systems into modular systems enabling the mixing and matching of components from different vendors (Schilling, 2000). Modularity has resulted in the evolution of platform architectures that partition the industry ecosystem into a relatively stable platform and a complementary set of modules that are encouraged to vary and evolve (Baldwin and Clark, 2000; Baldwin and Woodard, 2009; Katz and Shapiro, 1994; Sanchez and Mahoney, 1996; Tiwana, Konsynski and Bush, 2010). Increased modularity of digital systems has unleashed a broad wave of entrepreneurial firms that innovate and launch modules (of compatible applications) to align with specific platform architectures.

In digital platform settings, there is, thus, a strong interdependence between entrepreneurial firms that launch specific modules and platform firms for whom they launch their modules. For example, in the video game industry, the success of video game consoles is dependent on the availability of game titles (modules) launched by independent third-party developers. These third-party developers in turn rely on the availability of compatible platforms to launch their modules on. Given the strong mutual dependency for success, platform firms spend considerable resources attracting third-party developers to their platform while developers are also continually assessing the platforms to support.

In order to garner greater support from third-party complementors, platform firms strive
to attract a larger number of users to their platforms and in the process build a higher installed base. High installed base for the platform creates incentive for entrepreneurs to introduce more complementary modules (Cusumano and Gawer, 2002; Rochet and Tirole, 2006; Armstrong, 2006; Evans and Schmalensee, 2008). Since there are increasing costs associated with supporting multiple technologies, entrepreneurs face a technology adoption choice similar to that of consumers (Schilling, 1998). Supporting a platform with a large user base will be more valuable to entrepreneurs as they offer the biggest potential market for their complementary products (Venkatraman & Lee, 2004). The increasing value that accrues to entrepreneurial third-party complementors from supporting a platform with the largest installed base is termed as indirect network effects (Van de Kaa et al, 2011; Cennamo and Santalo, 2013; McIntyre and Srinivasan, 2017) and is a basic premise of competition in digital platform settings. An entrepreneur’s choice of platform to support, thus, is likely to be strongly influenced by the presence and strength of network effects for the platform. This is especially true during early stages where entrepreneurs are attempting to achieve initial launch success.

While the presence of network effects and installed base advantages are critical determinants of success in platform industries, these settings are also characterized by technological innovations that often lead to the introduction of new platforms and new competitors (Gallagher and Park, 2002; Venkatraman and Lee, 2004). The launch of new platforms and emergence of new competitors poses a new challenge for entrepreneurs as they attempt to scale up – should they continue to leverage the network effects and installed base advantages by linking to dominant platforms or should they seek economies of scope advantages by spreading their resource base across platforms and ensuring that their modules are not crowded out by those of competitors? As such, during scale up entrepreneurs are more likely to
shift their focus towards expanding their offerings beyond a single dominant platform to ensure that they do not fall behind.

The dynamism of digital platforms implies that the architectures of digital platforms are continuously evolving as evidenced, for instance, in the video game industry—that since the 1980s has witnessed frequent architectural shifts, with new generations of consoles with improved speed, memory and graphics capabilities being launched at frequent intervals (Gallagher and Park, 2002; Clements and Ohashi, 2005). Likewise, the smartphone industry has evolved rapidly, fueled by the ability of firms like Apple and Samsung to provide significant increases in performance for the same or lower price for each new generation of handsets. As such, technological discontinuities have the potential to render existing platforms obsolete (van de kaa et al, 2011) which in turn means that digital entrepreneurs supporting platforms need to be able to navigate the new technological trajectory to remain relevant.

Therefore, entrepreneurs in digital platforms require access to technological resources in order to be able to successfully launch their modules and navigate the dynamism of platform settings. Such technological resources typically are in the form of toolkits that provide basic training and interfaces and libraries of commonly used modules that entrepreneurs can incorporate into their applications (Von Hippel & Katz, 2002; Evans, Hagiu & Schlamensee, 2006). As such, the stronger the relationships that entrepreneurs are able to establish with platforms, the higher the likelihood of receiving preferential advantages from platform firms that allow them to launch superior applications at a faster pace than competitors.

In summary, entrepreneurs in digital platforms win with an appropriate sequence of strategic design moves and countermoves (Woodard, 2008) based on their own capabilities and competitive positions but also the relative position of the platforms that they seek to support. As
entrepreneurs make their linkage decisions, they face the choice of when to launch new complementary modules on a platform and which platforms to launch their modules on, in order to maximize their likelihood of success. Thus, the linkage moves orchestrated by entrepreneurs are critical sources of success in platform-based settings as these moves enable firms to reap some of the network externality advantages of platform-based settings (Garud and Kumaraswamy, 1995; Schilling, 1998).

Combining the two theoretical perspectives

Each of the perspectives described above has important implications for how competition plays out and entrepreneurs succeed in digital platforms. The choices of digital entrepreneurs in their module networks are a function of the position of the platform in the network (which determines platform success), the architectural/technology choices the platform firm makes and the prior relationships established with platform firms. Similarly, the resource networks define the limits of entrepreneurial success under digital platforms. Digital entrepreneurs with greater access to venture capital firms are more likely to augment their resource base (both financial and human capital) allowing them to develop better quality modules for platforms.

Moreover, the ability of entrepreneurs to simultaneously leverage their relationship capital from their positions in their resource and module networks is likely to be mutually reinforcing. As mentioned earlier, ties to high status venture capitalists serve as signals of the attractiveness and potential of entrepreneurs (Podolny, 2001) and thus, might result in preferred status from platform firms. Likewise, ties to high status platforms, in addition to providing resources such as technical innovations, product development capabilities, and access to customers also serve as a signal of their attractiveness, thereby, attracting investments from high
status investors – critical for sustained growth. As such, the choices that entrepreneurs make with
respect to supporting platforms are likely to influence their ability to receive support from
venture capital firms and vice versa. Therefore, we assert that an integrated view allows us to
better understand actions and subsequent success of entrepreneurs in platform settings.

The network perspective provides a useful lens to combine the resource and module
perspectives - how and when digital entrepreneurs choose to link their modules to specific
platforms are likely to be determined by their own ability to build on past advances to align with
changing platform designs and simultaneously leverage the value of network effects accruing to
platforms. These linkage choices, in turn, have important implications for their ability to succeed
in these dynamic settings.

A digital entrepreneur’s decision to link their modules to a specific platform is a strategic
choice that reveals their relationship intent and plays an important role in their success in
platform-based settings (Venkatraman and Lee, 2004). In order to succeed in a highly
competitive environment, developers must strive to link to platforms that allow them to leverage
the benefits of network effects while at the same time ensuring that their modules are sufficiently
differentiated from the competition. Moreover, the dynamism of these settings implies the path
dependency in the preferential attachment choices and their outcomes for digital entrepreneurs.
When technologies advance rapidly and at uneven paces, the linkage choices of digital
entrepreneurs can enhance or constrain their ability to navigate these technological changes.

Prior research on preferential attachment in organizational networks has focused on the
partner selection process of firms and the potential advantages that accrue by virtue of linking to
certain partners. For instance, studies have focused on how the network positions of actors
influence their likelihood of attracting ties. Such studies have supported the notion that linking to
dominant actors in a network provides legitimacy and stability, thereby, reducing market uncertainty (Oliver, 1990; Podolny, Stuart and Hannan, 1996; Podolny, 2001). Other studies have corroborated these studies by demonstrating that linking to dominant actors provides superior access to resources, knowledge and expertise, thereby enhancing a firm’s innovative capabilities (Podolny et al., 1996; Powell, Koput and Smith-Doerr, 1996; Ahuja, 2000; Schilling and Phelps, 2005). Another stream of research has focused on how an organization’s likelihood of survival decreases with network characteristics of ‘crowding’ (competitive similarity and niche overlap) but increases with ‘status’ (competitive differentiation) in un-crowded niches. For instance, Podolny et al. (1996) using patent data on semiconductors during 1984-1991 showed that these network characteristics significantly impacted organizational growth.

Yet other studies have focused on how an actor’s prior ties influence their choices in future partner selection and consequent performance. There is general acceptance that organizational actions are embedded in networks of relationships (Granovetter, 1985; Gulati and Gargiulo, 1999; Powell et al., 2005), with actors tending to reinforce their existing ties with partners. Embeddedness has been shown to be linked to superior firm performance by engendering familiarity and trust (Granovetter, 1985; Gulati, 1995; Gulati and Gargiulo, 1999) and by the development of a common knowledge base that is beneficial when the reinforcement of the current strategic or technological trajectory is required (Madhavan, Koka and Prescott, 1998).

While most of these studies adopting the network perspectives have focused on vertical relationships involving buyers and suppliers along the value chain, network theories can be used to gain greater insight into platform-complementor relationships and their evolution over time. In platform settings, the preferential attachment choices of developers are critical to predicting
their success outcomes in the long run. Linking modules to dominant platforms can provide important benefits such as the ability to exploit some of the advantages of strong indirect network effects enjoyed by these platforms (Venkatraman and Lee, 2004) and access to resources required to rapidly deploy and differentiate their modules from those of competitors.

Moreover, when digital entrepreneurs link to specific platforms, they align their knowledge and routines around the given platform’s architecture. In doing so they are coupling their outcomes to that of the platform. This embeddedness in a platform’s architecture has important implications for the ability to balance their links across platforms over time. Technological advances in high-tech settings imply frequent launches of new platforms, the entry of new competitors, and new competitive moves by both digital entrepreneurs and platforms (Gallagher and Park, 2002). The initial linkage decisions that developers make are likely to influence their ability to evolve their linkages with technological advances and navigate the dynamism of these settings. We, therefore, contend that a developer’s linkage decisions are a critical predictor of their initial launch success and their ability to navigate the dynamism of platform settings.

PROPOSITIONS ON ENTREPRENEURSHIP IN DIGITAL PLATFORMS

We derive our propositions on the potential outcomes of the preferential linkage decisions of entrepreneurs by integrating key insights from the two theoretical strands discussed above. Our propositions focus on how entrepreneurs in digital platforms maximize their initial launch success (first stage) and how they navigate the dynamics through effective and timely adaptation (second stage). Surviving in platform settings is especially challenging for new entrepreneurial developers seeking to link to platforms. Entrepreneurial research has demonstrated low probability of survival for new organizations (Freeman, Carroll and Hannan,
1983), and for technology-based firms (Nesheim, 1997). This ‘liability of newness’
(Stinchcombe, 1965) of new organizations stems from the organizations' general lack of
resources and legitimacy that leave them with reduced ability to compete with established
players. For an entrepreneur, while constructing an initial resource base is a challenge,
each resource choice has significant implications for survival and growth. Therefore, while the
early choices an entrepreneur makes during initial launch of their ventures are critical for
success, future value creation cannot occur without growth, and entrepreneurial growth during
scale-up has numerous challenges that entail developing marketing strategies, building the team
by hiring and managing diverse groups of people, and acquiring further strategic inputs such as
the right kinds of capital and suppliers (Isenberg, 2012).

These decisions during scale-up become even for salient in platform settings that are
characterized by inherent dynamism as reflected in rapid shifts where technological generations
coe-exist and platform-complementor interactions balance the requirements of supporting current
and emerging platforms. The liability of newness is, thus, a key challenge for new firms in
digital platform settings, as in addition to the factors above, they often need to fill considerable
resource needs to keep pace with rapid technological change and innovation initiated by platform
providers. Therefore, key moves and linkage decisions that digital entrepreneurs orchestrate to
form their initial networks and evolve them over time have important implications not only for
the initial launch success but also for their continued success and survival. To better understand
the success of entrepreneurial developers in these settings, we posit that their choices evolve over
two stages: choices that guide launch decisions focused on initial choice of platform to support,
alignment with platform architectures and access to financial resources. Over time, the focus
shifts to navigating the dynamism of these settings, which we characterize as the second stage
scale-up choices. We, next, present a set of propositions focused on the first stage choices of developers that reflect the initial launch success followed by continued success over time defined by their second stage decisions.

**First stage choices and initial success**

Entrepreneurial success depends upon the ability of entrepreneurs to leverage their relationship capital through connections to and investments from venture capitalists. Podolny’s (2001) study that an actor’s social status serves as a strong signal for quality has had a strong influence on entrepreneurship studies where there is considerable uncertainty about the prospects (Stinchcombe, 1965; Aldrich and Auster, 1986) and quality of a new venture (Stuart et al., 1999). There is especially strong evidence of these effects in the venture capital industry. For instance, prior research has shown that when investors and entrepreneurs share overlapping networks, investors can acquire information to assess an entrepreneur’s reliability, integrity and business acumen allowing them to make better investment decisions (Amit, Glosten, and Muller, 1990; Fried and Hisrich, 1994; Shane and Stuart, 2002). Similarly, Stuart et al. (1999) and Stuart (2000) argued that endorsements of entrepreneurial ventures by high-status partners leads to success by reducing uncertainty and facilitating the process of resource mobilization.

In digital platforms, the networks that entrepreneurial developers establish with a multitude of institutions such as platform firms and venture capital firms are critical and distinguishing features of success – these networks have had special importance in the movement the evolution of influence and power, and the actual production of innovation (Saxenian, 1994; Castilla et al., 2000). Another key advantage of relationship capital is access to venture capital funding that is critical for mobilizing both human and financial capital and especially critical...
during early launch success. Moreover, consistent with prior research that a firm’s partners act as signals of firm status and quality (Podolny, 2001), we argue that as entrepreneurs establish relationships and secure funding from high status venture capital firms, they signal their own attractiveness and potential for success and would be better be able to mobilize resources from their other networks such as platform firms. Therefore, the connections that digital entrepreneurs establish in their resource networks are likely to determine launch success. Specifically, we propose:

**Proposition 1:** Entrepreneurs in digital platforms increase their chance of launch success by linking to prominent (high status) actors in the resource network.

New digital entrepreneurs must also decide which platforms to support at launch. The key goal for entrepreneurs in this stage is to establish initial launch success and set themselves up for future growth. The initial linkage decisions and resource management choices of digital entrepreneurs are of special significance as these decisions influence and limit the future path of evolution in the long run (Boeker, 1989, Gersick, 1991 and McDougall, Shane and Oviatt, 1994) and have significant impact on venture performance and survival (Bamford, Dean and McDougall, 1999; Hambrick and Mason, 1984; Boeker, 1989; Smith et al., 1994; Hambrick, Cho and Chen, 1996 and Shephard, Douglas and Shanley, 2000).

Within digital platforms, linking to dominant platforms likely provides advantages emanating from network effects that manifest through strong positive feedback (Arthur, 1989; Katz & Shapiro, 1994). Entrepreneurs, who are able to link to dominant platforms with the largest installed base, are likely to succeed in the initial stage because those platforms offer the biggest potential market for their applications (Venkatraman & Lee, 2004). Studies have also demonstrated that dominant actors attract more network partners for reasons of legitimacy and
stability (Oliver, 1990) and such attraction to dominant partners gives credence to the ‘rich-get-richer’ mechanism (Barabási, 2002) – similar to the phenomenon of positive feedback observed in digital platforms (Katz and Shapiro, 1986; Arthur, 1989).

In addition to offering a large market for a digital entrepreneur’s modules, dominant platforms are also likely to have more widely available components and toolkits (Katz and Shapiro, 1994) allowing entrepreneurs to launch better quality modules faster without incurring significant relationship-specific investments. Linking to dominant platforms also provides additional advantages such as the ability to exploit the relationship capital from these networks of connections to attract investments from venture capitalists for future growth. Thus, we advance our second proposition:

*Proposition 2: Entrepreneurs in digital platforms increase their chances of launch success by linking to dominant platforms in their module networks.*

**Second stage choices and sustainability of success**

While initial launch success is determined by a digital entrepreneur’s early linkage decisions, success and survival over time will depend on their ability to rapidly scale up to support multiple platform technologies simultaneously. The growth stage in digital platforms is characterized by network changes associated with the entry of new, competing technologies within and across technological regimes as well as entry by other entrepreneurs. Success during these stages will be determined by the ability to navigate the dynamism and rapid technological changes. As platform technologies evolve and newer platforms are launched, developers’ success will depend on their ability to realign their knowledge along the new technological trajectory.

In addition to navigating their positions within their module networks, entrepreneurs need to be able to leverage their resource networks to rapidly scale up and adapt to new competitors.
and platform technologies. Network ties with venture capital firms serve as conduits providing them with valuable resources. While initial resource requirements for an entrepreneur launching a single application on a single platform may not be very high, access to resources take precedence during scale up stage for two reasons.

One: As platforms grow their installed bases and gain in popularity, they receive increasing support from large sets of third-party developers. As platforms become more crowded, digital entrepreneurs face the challenge of making their modules stand out among those of the competitors – requiring significant investments in marketing their applications. For instance, despite Angry Birds occupying a spot in the Top 25 list of the Apple App store ever since its feature on Apple UK, it has faced intense competition from several other apps, old and new, that have been vying to displace it from its dominant position. However, Rovio has been able to sustain its dominance by investing significantly to establish Angry Birds as more than just a game - it has taken steps to create a franchise and the ‘Angry Bird’ brand to ensure their constant popularity in app stores.

Two: As new platforms emerge often with radically different technologies, developers face the challenge of advancing their knowledge and routines along the new technological trajectory requiring significant investments. Thus, access to funding is critical to continued success for entrepreneurial developers. Prior research within the entrepreneurship literature has demonstrated that founding teams with prior venture experience (Hsu, 2007; Gompers et al., 2008) and with direct network contacts (Bygrave and Timmons, 1992; Shane and Stuart, 2002) are more successful in securing financing from venture capitalists – an important precursor to success.

For entrepreneurial developers with limited resources, their ability to exploit their
relationship capital from their network connections will be a critical source of success – specifically, embedding themselves in relationships with venture capital firms can allow third party developers to exploit their connections to attract more financing, that allows them to scale up and grow more rapidly. For instance, Rovio’s tremendous success on the dominant iPhone platform, was instrumented by it receiving a $42 million investment from Accel Partners, Atomico Ventures, and Felicis Ventures LLC, all venture capital firms. The investment allowed Rovio to continue its international expansion across mobile platforms, social media markets, and beyond. Moreover, entrepreneurial firms that form strong relationships with dominant venture capital firms, are more likely to be visible to other resource providers such as new platform firms interested in the entrepreneurial activities introduced by the firm (Stuart, 1999; Stam and Elfrig, 2008). As a result, the increased legitimacy and visibility emanating from their embedded relationships with venture capital firms may increase the attractiveness of digital entrepreneurs and afford them preferential treatment from multiple platform firms allowing them to navigate the dynamism of platform settings. We, therefore, propose:

**Proposition 3. Entrepreneurs in digital platforms increase their chance of scale-up success through their embedded ties in their resource networks.**

An entrepreneur’s strategy, in addition to its ability to leverage its resource networks, evolves as a function of its relative network position in the module network. This is in line with the network perspective that recognizes the role of a firm’s prior network positions in influencing its future strategic choices (Granovetter, 1985; Gulati, 1999; Powell et al., 2005; Venkatraman & Lee, 2004). Previous studies on network embeddedness have emphasized its value, while another set of studies has shown that in periods of sudden environmental change, certain network relations can become a bottleneck (Mitchell and Singh, 1996; Uzzi, 1997; Afuah and Werner, 2007), and firms are unable to dissolve their relationships due to high embeddedness (Kim, Oh
and Swaminathan, 2006). Embeddedness also prompts actors to become less willing to engage in partnerships outside of these close relationships (Uzzi, 1996; Uzzi, 1997; Venkatraman and Lee, 2004).

Within platform settings, the coordination of product launches is a distinguishing characteristic of competition and success (Arthur, 1989; Shapiro and Varian, 1999). The relationships between platforms and digital entrepreneurs are not atomistic market-based transactions but rather, the actions of digital entrepreneurs reflect their prior ties and patterns of embeddedness reflect the distribution of modules offered by them to different platforms (Venkatraman and Lee, 2004). Therefore, a digital entrepreneur is tightly coupled or embedded when its set of modules is spread over a small number of platforms; and as such, this digital entrepreneur does not support a large number of platforms. Consequently, more embedded entrepreneurs are likely to be locked in to a single platform technology. Over time, every new platform introduction potentially alters the established network of links between digital entrepreneurs and platforms (Venkatraman and Lee, 2004). New platform technologies can destroy the competencies of some developers thus posing a new challenge for all digital entrepreneurs. Specifically, embeddedness of a digital entrepreneur may be a liability in such situations as a digital entrepreneur is locked into its current offerings and is unable to adapt to changing technology requirements. Therefore, embedded entrepreneurs would be less likely to migrate to newer competing platforms and hence may not be able to achieve the levels of growth of entrepreneurs who have greater linkage diversity with their modules spread across platforms.

For instance, Zynga’s inability to escape from its dependence on the Facebook platform has been viewed as a reason for its lukewarm post IPO performance. Its strong embeddedness to the Facebook platform meant that its games didn’t spread as fast and its success was tied to the
fortunes of Facebook. On the other hand, Rovio’s ability to expand their scope and rapidly translate their games across multiple smartphone platforms after their initial success on the iPhone platform has been attributed to their meteoric success.

We, next, venture to understand whether embeddedness in certain platform networks impacts all entrepreneurial developer teams equally. In platform settings, start-up application development firms are often founded by teams with prior experience in application development. For instance, a large number of firms in the video game development business such as Radical Entertainment, Valve Software have been founded by employees from firms such as Electronic Arts, Microsoft and IBM. Such founding teams bring a breadth of experience on working with different platform technologies. Within the entrepreneurship literature, the role of founder team experience and diversity on venture success has been studied extensively. For instance, Hambrick et al. (1996) find that heterogeneous teams are more likely to react to changes in the environment. Heterogeneous teams have also been found to perform better in complex and turbulent environments (Keck, 1997) and are an antecedent to economic performance in high-technology firms (Smith et al., 1994). We, predict, that in platform-based settings, the diversity and prior experience of founding teams will moderate the impact of the liability of embeddedness for developers during periods of technological change. Specifically, as new platform technologies emerge, founding teams with a diversity of experience will be able to leverage their existing competencies and know-how to navigate across multiple technological regimes and will be able to better and more rapidly scale up than developers with no prior experience in diverse technologies. Therefore, we propose:

*Proposition 4a: Entrepreneurs in digital platforms increase their chance of scale-up success with a greater diversity of ties in their module networks.*
We, next, seek to address how evolution of platform networks over time influences the likelihood of survival for digital entrepreneurs. We proposed that developers that link to dominant platforms first are more likely to achieve launch success by virtue of access to the largest market for their applications. However, can this advantage of linking to dominant platforms be sustained over time? Recent studies attempting to study the dynamics of network formation and evolution have focused on the rationale for attaching to various actors. In platform settings, moves of developers are intricately related to the moves of others. Theories of preferential attachment posit that network evolution often exhibits a rich-get-richer mechanism whereby dominant nodes continue to attract new ties (Barabasi, 2002). In the context of platform-based settings, dominant platforms are more likely to attract new entrepreneurial developers resulting in niche crowding and increasing overlap in digital entrepreneurs’ offerings.

Prior studies on the dynamics of competition among firms have studied the impact of density overlap or domain similarity on organizational performance and survival (for instance, Baum and Singh 1994; Stuart, 1999; Greve, 2000). Such studies have found that organizations in crowded niches face increased competition and pressure to innovate, which may have an impact on organizational mortality rates. In our setting, if a digital entrepreneur finds itself with considerable domain similarity to other entrepreneurs vying for attention on a given platform, they may lose their differentiation and competitive advantage. As a result, digital entrepreneurs need to be able to balance the increased competitive intensity with the advantages associated with supporting a dominant platform. Therefore, over time the advantages associated with supporting a dominant platform may diminish with increased overlap in developer offerings and increased competitive intensity:
Proposition 4b: Entrepreneurs in digital platforms increase their chance of scale-up success by reducing the overlap of their modules with those of competitors in their module networks.

While each of the choices described above are likely to have important implications for platform success, we further venture to theorize the combined impact of a digital entrepreneurs’ linkage decisions in their resource and module networks during initial launch and scale up. Prior research has examined the role of resource interactions in driving firm success in a multitude of settings. For instance, Tanriverdi and Venkatraman (2005) in their study of Fortune 1000 firms find that the joint effect of three complementary knowledge forms enhances firm performance. Similarly, King et al (2008) find that the complementary effect of a firm’s technology and marketing resources helps explain firm performance in the context of acquisitions. These studies on complementary resources underscore the importance of having specific interconnected resources (Christman 2000, Moorman and Slotegraaf 1999, Tanriverdi and Venkatraman 2005).

The fundamental premise underlying these studies that resource complements represent a valuable source of asymmetry (Miller 2003) whereby the marginal benefit of each resource increases with the level of the other resource applies in platform-based settings as well. In platform settings the choices a digital entrepreneur makes during both initial launch and subsequent scale up are likely to be mutually reinforcing. While during the initial launch stage an individual entrepreneur is likely to maximize launch success by linking to dominant platforms and gaining access to financial resources from their VC networks; their ability to leverage the complementarity across these choices is likely to have greater impact on initial success. For instance, while linking to dominant platforms is clearly beneficial for digital entrepreneurs, it also increases their legitimacy, thereby, allowing them to access venture capital funding so critical for initial launch success. When digital entrepreneurs are able to launch successful applications on dominant platforms, they help venture capital firms overcome information
asymmetry allowing them to make more informed decisions on which entrepreneurial venture to fund (Gompers and Lerner, 2000; Shane and Cable, 2002). Relatedly, the funding they receive from venture capital firms is likely provide digital entrepreneurs the resources required to launch better quality modules for platforms, thereby increasing their chance of success. As such, linkage choices that digital entrepreneurs make during start up in their module and resource networks are mutually reinforcing. Likewise, during scale up, the ability of digital entrepreneurs to contemporaneously leverage their resource positions to respond to platform architectural shifts and competitor moves is likely to allow them to adapt and scale up more rapidly. As digital entrepreneurs increase their reach during scale up by supporting multiple platforms simultaneously, they are able to use their enhanced network positions in their module networks to gain access to superior resources like further funding and human capital to expand their resource networks. Given the positive reinforcement between a digital entrepreneur’s choices in their module and resource networks, we propose:

Proposition 5: The interaction between linkage to dominant platforms in module networks and linkage to dominant actors in resource networks will increase the likelihood of initial launch success.

Proposition 6: The interaction between diversity of ties/reduced overlap with competitors in module networks and embeddedness in resource networks will increase the likelihood second-stage launch success.

Figure 1 summarizes our propositions and the interconnections among the research strands that help describe drivers of entrepreneurial success across two stages in platform settings.

{Insert Figure 1 here}
An important and emerging area of strategic entrepreneurship focuses on how new organizations—that are born in the digital era—develop and adapt their strategies and business models when their products and services are to be coordinated within and across digital platforms. In this paper, we have argued that such type of entrepreneurship must, at minimum, recognize how entrepreneurs take into account the choice of (1) platforms reflected by economic logic of network effects; and (2) preferentially link to different platforms based on the dynamic characteristics of networks of interdependencies between key actors. In doing so, we have made a case for moving away from framing strategic entrepreneurship as autonomous actions but coordinated within network of influences. Such a network-centric view theorized how entrepreneurs position and adapt their position in networks to achieve launch success and continued success over time as digital platforms (Shapiro & Varian, 1999; Eisenman, Parker & Van Alstyne, 2006) evolve along multiple technological trajectories (Ancona and Tushman, 2001) requiring continued support from entrepreneurs. While the economics literature on platforms has paid more attention to those firms designing and orchestrating the platforms, we have argued that the role of entrepreneurs in supporting such platforms is equally important and worthy of research.

Our stylized sequence of decisions by entrepreneurs in digital platforms began with the entrepreneurs’ ability to access financial resources from high status venture capital firms that signal the distinctiveness of the innovation supporting dominant platform such as Android or Xbox at that time. We further posited that supporting such dominant platforms, also earns their favor by receiving unique access to resources and connections to prominent high-status investors to further accelerate future growth.
Over time as entirely new platforms emerge or newer generations of current platforms evolve, entrepreneurs succeed by capitalizing on opportunities to re-use their specialized knowledge and routines by re-launching their existing products and services to newer settings. In such situations, continuing to be embedded in crowded platforms would be detrimental to entrepreneurs' survival. We also sought to reconcile the traditional view of entrepreneurship success as emerging from founder characteristics and their personal networks with the view that coordinated product launches and linkage decisions are critical for success in platform settings. We, specifically, posited that these resources enhance the ability of entrepreneurs to navigate effectively during periods of technological change. Our study also recognized the complementarity among entrepreneurial actions with respect to leveraging their resource networks and module networks to achieve optimal outcomes during initial launch and scale up.

Since digital platforms are fast-paced, we need theorizing that recognizes the inherent dynamics along multi-time periods. Several settings are potential candidates for further theorizing and empirical research. Videogames with over three decades of entrepreneurship focused on design and development of games has served as rich setting with some prior work but with limited focus on network effects. Over the last decade, we have seen growing entrepreneurship with developers supporting platforms such as Apple iOS, Google’s Android, Facebook, Twitter, Netflix, Amazon and others. Indeed, success of platforms requires support from applications and entrepreneurs in such settings play critical role in making some platforms succeed relative to others. While many anecdotes exist about the importance of accessing venture capital funding from high status firms in Silicon Valley, limited research has been carried out to understand how such firms navigate the complex landscape of linking and adapting to different platforms within dynamic networks. Future empirical research could build on our theory to
analyze how the linkage choices of app developers in their module and resource networks in settings such as smartphones and video games drive their performance outcomes. The prevalence of a thriving market for third-party applications in a diverse range of technological settings such as PCs, smartphones and tablets makes this area of research timely and central to the field of strategic entrepreneurship.

IMPLICATIONS FOR ENTREPRENEURSHIP RESEARCH

While our study specifically focused on entrepreneurship in digital platforms, we believe it has important implications that can be generalized to other settings as well. While digital platforms provided a unique setting in which the success of digital entrepreneurs is intricately linked to the platforms they choose to support and hence their positions and moves in their module network, the reliance on networks of relationships is not constrained only to these settings. For instance, in a multitude of industries such as biotechnology, entrepreneurial firms rely on alliances and partnerships with larger incumbent firms. In such situations, however, the value created by alliances is typically appropriated by the larger firm (Alvarez and Barney, 2001). Insights from our theory can be used to understand how smaller entrepreneurial firms can appropriate more value from these relationships. For instance, when they increase their legitimacy through strong embeddedness in resource networks, they are enhancing their status and leverage in their module/alliance networks. Moreover, relying on a diverse set of partners also helps with survival. Specifically, our focus on complementarities across different types of networks is relevant in a multitude of industries beyond digital platforms. To our knowledge, most research on entrepreneurship, while recognizing that entrepreneurial firms participate in different types of networks, have focused only on relationships within one type of network and
not on the complementarities that emerge from their participation in multiple networks simultaneously.

Another contribution to extant research is the recognition of the inherent dynamism of entrepreneurial ventures and the need to adjust network relationships to reflect different stages of entrepreneurial growth. In digital platforms, we theorized that as entrepreneurial firms emerge, their networks consist primarily of ties and linkage decisions focused on building their identity. As firms move into the scale-up stage, their networks evolved towards ties based on the economic costs and benefits of the relationship (Hite and Hesterley, 2001) and the degree to which they differentiated them from their competitors. This shift from identity-based to more calculative networks is manifested in the evolution of the firm networks from merely trying to link to dominant partners to a more intentionally managed network that focuses on a combination of embedded relationships and variety of relationships in their resource and module networks respectively. It would be useful to advance theory on whether dynamics similar to these apply in other industry settings as well.

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Figure 1: Summary of propositions on entrepreneurial success in digital platforms
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