Accelerators as Start-up Infrastructure for Entrepreneurial Clusters: The Australian Example

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1 Abstract

Infrastructure is commonly conceptualized as a set of facilities that play a critical role in facilitating activities by individuals and organizations. Conventionally, infrastructure is tightly linked to publicly funded projects that facilitate access to key resources and enable diverse activities. Within entrepreneurial clusters research, infrastructure includes universities, research institutions, and telecommunication technologies that facilitate entrepreneurial activities. These capital-intensive investments seek to facilitate start-ups emergence by aiding access to markets and development of ideas. Accelerators facilitate the same activities and have only recently been conceptualized as *start-up infrastructure*. This study builds upon this research stream by elaborating on how accelerators can play this meaningful role at the cluster level. Specifically, and by relying on the analysis of empirical evidence from three distinct studies, we uncover how accelerators provide tangible and intangible dimensions of start-up infrastructure to form a positively reinforcing cycle of entrepreneurial activities. Additionally, our findings allow us to push further the idea that start-up infrastructure development can be an endogenous process involving multiple actors within the cluster. Our empirical findings and the theoretical insights derived from them have meaningful implications for the aforementioned literature, as well as start-up practitioners and policy-makers linked to the funding of entrepreneurial clusters.

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> "Public infrastructures to support innovative entrepreneurship are among the instruments that governments deploy to strengthen entrepreneurship and innovation (OECD 2011). Such ***infrastructures act as intermediaries*** (Chatterji, Glaeser, and Kerr 2013), and their principal mission consists of providing services that aim to boost one or more phases of innovative activity in the fields of knowledge and technology creation and acquisition. Public infrastructures also prepare companies to produce and commercialize their products or services" Roig-Tierno, Alcázar, and Ribeiro-Navarrete (2015, 2291-92, emphasis added).

> "More generally, infrastructure is found to be positively associated with start-up activity. However, the association is ***apparently specific to both the particular type of infrastructure, as well as the particular industry context***…" Audretsch, Heger, and Veith (2015, 226, emphasis added).

2 Introduction

Infrastructure is a key part of any economic development process (Eberts 1990; Pradhan, Arvin, and Norman 2015; Pinder 2017). In particular when dealing with entrepreneurial activities, Van de Ven (1993) classifies *entrepreneurial infrastructure* as: (1) "proprietary functions" such as marketing, new product development, R&D, and financial support; (2) "public resource endowments" such as culture, financial resources, human capital, and social capital; and (3) "institutional arrangements" including regulations, technology and marketing standards. Recent work by Roig-Tierno et al. (2015) and Audretsch et al. (2015) augment this conceptualization of the infrastructure required to stimulate entrepreneurship and economic development. Infrastructure is not just for each organization, but also to bring them together to cooperate by providing "points of growth" (Kozhukhivska et al. 2017). An infrastructure perspective of clusters accommodates the diversity of stakeholders in the cluster and how they collectively contribute to the cluster's dynamics.

Recently a few scholars have explored the possibility that other activities and organizations can be conceptualized as playing a key part in developing and sustaining the

infrastructure of entrepreneurial clusters. In particular, some of these investigators have hinted that accelerators can be influential organizations that can contribute to start-ups infrastructure (Gonzalez-Uribe and Leatherbee 2017; Nadgrodkiewicz 2014; Pauwels et al. 2016; Roberts et al. 2016). These suggestions, although unorthodox, might be quite impactful considering how the funding of infrastructure to support start-ups has become quite a popular public policy prescription to spur economic growth (Mazzucato 2014; Hathaway 2016; McCrossin 2016). Unfortunately, our understanding of the process by which these relatively novel organizations might become a key part of the ecosystem infrastructure is quite limited.

In trying to advance our understanding of how accelerators might accomplish these lofty goals this study combines three empirical studies, analyzing data collected from accelerators founders, accelerators operators and start-ups founders in Australia. The first study analyzes interviews with accelerator founders and operators about the intention and evolution of the accelerators with respect to how these organizations might play a role in creating and sustaining start-up infrastructure. The second study follows-up the first study by investigating the evolution of these organizations, and their most recent operational model extended the intentions and actions of the accelerator's founders. The third study triangulates the claims made by accelerators personnel, using a survey of start-ups who have been somehow supported or helped by these accelerators.

By studying accelerators and their community, this study brings new insights about how accelerators situate themselves within the greater cluster and stimulate entrepreneurship and economic development at the cluster level. In addressing the research question of how accelerators develop start-up infrastructure, this study explicitly builds upon Emery and Flora's (2006) Community Capital Framework (CCF) by establishing a conceptual link between accelerators and the different Community Capitals and elaborates on how the different Community Capitals interact to generate a virtuous cycle. CCF is a particularly

powerful framework to frame our findings because of its dynamic and interactive approach to explain how infrastructure (for entrepreneurial clusters) is a multi-dimensional process hinging upon interaction of the different capital dimensions.

The rest of the paper is structured as follows. First, we explore the most relevant literature on infrastructure for entrepreneurial clusters. Second, we briefly review how accelerators have been conceptualized and how they have recently been linked to start-up infrastructure. In trying to elaborate these initial insights on the role of accelerators within entrepreneurial clusters, we draw on empirical research for the Australian context to explore how accelerators may become a key part of a cluster's start-up infrastructure and thus generate a virtuous cycle of economic development. We conclude the paper with key theoretical, practical and policy-making implications and insights.

3 Literature Review

The relationship between infrastructure and entrepreneurship is a topic of increasing academic and public policy interest (Van de Ven 1993; Callaway 2004; Liao, Welsch, and Pistrui 2009; Woolley 2014). Audretsch et al. (2015) find that infrastructure for an innovation-driven start-up economy includes R&D institutions and research universities who provide talent (people) and knowledge (ideas). Infrastructure for start-ups also includes digital technology infrastructure by telecommunications companies (Autio et al. 2018), and technical assistance and consulting services by professional service intermediaries (Mas-Tur and Soriano 2014). However, there remains a gap in research that explicitly considers how different processes at the level of the community might affect the effectiveness of the cluster as a whole. Indeed, Roig-Tierno, Ribeiro-Soriano, and Mas-Verdú (2017) explicitly call for research on the infrastructure to support innovation and clusters. We dive into this broad literature as the first step to recognize what is known about the nature of start-up infrastructure.

3.1 Infrastructure for Entrepreneurial Clusters

> "'Clusters' are geographical agglomerations of firms in particular, related, and/or complementary, activities, sharing a common vision, and exhibiting horizontal, vertical intra- and/or inter-sectoral linkages, embedded in a supportive socio-institutional setting, and cooperating and competing in national and international markets." Pitelis (2012, 1361)

This definition is less specific about the diversity of the organizations in their cluster, but does recognize their common vision, their linkages or interdependence, and their greater (national or international) context, where context can be understood as the "situatedness of entrepreneurial processes" (McKeever, Jack, and Anderson 2014, 50). At every level, context influences how the interrelated elements at lower levels will need to be coordinated to "enable productive entrepreneurship within a particular territory" (Borissenko and Boschma 2017, 9). The role of shared knowledge and the interconnectedness of innovation systems within the cluster's context offer an understanding of the cluster's economic potential (Audretsch and Belitski 2017).

The required infrastructure facilitating these relationships among key actors and institutions within these clusters has been conceptualized quite differently across the literature. For instance, Van de Ven (1993) proposes that infrastructure is exogenous to the business creation process. However, work by cluster scholars, such as Saxenian (1994), Aldrich (1990), Flora and Flora (1990; 1993), Cooke (2001), Emery and Flora (2006), and Audretsch and Belitski (2017) suggests that entrepreneurial initiatives shape a cluster's infrastructure. In other words, there is a recursive relationship, in that start-up infrastructure enables entrepreneurial activities and outcomes, and that (reciprocally), the development of start-up infrastructure itself is an outcome of the same activities (Roundy, Bradshaw, and Brockman 2018). As a result of this recursive relationship, there is in the inherent alignment of the objectives of the cluster and those in it toward the common vision. Whether

infrastructure can be conceptualized as either exclusively exogeneous or relatively endogenous is a continuous debate within this literature, and thus, something worth reconsider at the end of this study. We now move to briefly summarize the burgeoning literature hinting the potential role of accelerators as part of the start-up infrastructure.

3.1.1 Accelerators and Start-Up Infrastructure

In the broadest sense, Miller and Bound (2011) define accelerators as a "factory for start-ups." As factories, they are a capital-intensive investment that enables their operator to take in raw materials, transform them and manufacture start-ups. Like clusters, many accelerators target a specific sector, such as manufacturing or biotech (Hochberg 2015; Malek, Maine, and McCarthy 2014), while others have a horizontal perspective focusing instead on the region such as a state or territory (Price 2004); some even specialize in a specific demographic, such as women.

From this previous discussion, it seems clear that accelerators cannot be simply conceptualized as just passive physical infrastructure, like bridges, ports, or warehouses, but are proactively engaged in the cluster. So, what exactly do accelerators do? Bliemel et al. (2016) conceptualized accelerators as a combination of: (1) Standardized seed funding packages; (2) Cohort-based entry and exit; (3) A structured capacity development program; (4) Mentoring; and (5) Physical co-location, as also adopted by recent national policy (e.g., NISA's Incubator Support Programme in 2015) and recent critical reviews of the impact of accelerators (e.g., Miles et al. 2017). Seed funding from accelerators is typically standardized for all start-ups in the accelerator, usually in exchange for a standard proportion of equity. These funds are used to support the start-up team while they are devoting their efforts to the launch of their first product over the intensive three- to six-month program. This investment feature and the general absence of charging a fee for services or rent makes accelerators more

similar in many ways to business angels than real-estate based incubators (Cohen and Hochberg 2014; Bliemel et al. 2013; Ghosal 2015).

The second key feature of the accelerator business model is a time-boxed cohort model for participants (see Bliemel and Flores 2015; Bliemel et al. 2016; Dempwolf, Auer, and D'Ippolito 2014; Shane 2015). The competitive application process of accelerators forces an efficient and effective due diligence process and consistent selection criteria by the accelerator operators. Due to time constraints and for reasons of fairness and transparency, the investment terms are standardized. At the end of the process, there is 'graduation' from the accelerator, which culminates in a 'Demo-Day' (Dempwolf et al. 2014). Demo-Day involves accelerated start-ups pitching their latest business model to the cluster, ideally including investors from whom they compete for follow-on investment.

The third and fourth key features of accelerators are both related to learning. Accelerators offer a structured development program to the cohort for the first few weeks of a typical program and transitioning to a bespoke development platform that is delivered by mentors. Structured development programs include topics such as pitching and marketing the business, IP strategy, valuation and planning for the exit. After the initial phase, the educational program often becomes less formal and increasingly customized to the concurrent needs of the start-ups in the cohort. In that sense, the learning becomes less standardized and more personalized, commensurate with increased interaction with peers and mentors. Entrepreneurial learning is an experiential, social, dynamic, coordinated effort that is facilitated by the accelerator process of educational programs, mentors, and pitching to peers (Bygrave and Minniti 2000; Minniti and Bygrave 2001; Cohen 2013; Miles et al. 2017).

The fifth key feature of accelerators is to require start-ups to be co-located full-time in the same space. This enables and enhances informal and peer to peer learning opportunities and knowledge spillovers and creates efficiencies in program delivery. To save costs and

embed themselves within the entrepreneurial cluster accelerators are often located within an incubator or co-working space (Reimers et al. 2015), thus blurring the physical boundaries of the accelerator and their context. Co-working spaces can usually handle many more start-ups than those in the accelerator and often accommodate start-ups after they graduate so that they can further develop the human, social and financial capitals of the cluster; and sometimes tapping into their enthusiasm as mentors for newer start-ups. These mentors provide the start-ups guidance and informal management development assistance. They often have explicit economic interests in the success of the start-ups and are likely to be business angels or investors in the accelerator's fund (Bliemel et al. 2016; Bliemel et al. 2018).

Several studies propose comprehensive sets of objectives and success metrics for accelerators (e.g., Cukier and Middleton 2012; Dempwolf et al. 2014) which are virtually identical to those of entrepreneurial clusters. Caley and Kula (2013) indicate that the accelerated ventures' survival and growth metrics (jobs created, follow-on funding, and new customers) are more important than the accelerator's operational metrics (satisfaction, application numbers, and the number of mentors) or productivity measures (e.g., occupancy rate or profit margin). Because of the similarities between accelerator metrics and cluster metrics, many nations, regions, and communities are said to think of accelerators as a critical component of start-up infrastructure for the clusters of a new economy (Gonzalez-Uribe and Leatherbee 2017; Mian, Lamine, and Fayolle 2016; Nadgrodkiewicz 2014; Pauwels et al. 2016; Roberts et al. 2016). Accelerators within this literature are then purported to provide the context, resources and institutional environment to facilitate the creation and growth of start-ups (Hathaway 2016; Wright and Drori 2018).

Early accelerators were private sector operations, run primarily to provide longer-term benefit to these investors. However, many accelerators now receive direct public funding (Haley, Bone, and Allen 2017) or receive support from a publicly funded university. For

example, in 2014 the Canadian government provided CAD$100 million to support 16 accelerators for five years through the Canadian Accelerator and Incubator Program. Likewise, in the U.S. the Small Business Administration provided US$4.4 million to fund 80 accelerators in 2015. Similarly, in 2015, the Australian federal government established a multi-billion-dollar National Innovation and Science Agenda (NISA) to support collaborative research and development programs which included an AUD$23 million Incubator Support Program to support accelerators to drive a more innovative and entrepreneurial Australia (Australian Government 2015). Many states in Australia followed suit, such as the AU$18 million Boosting Business Innovation Program by the New South Wales (NSW) government which funded accelerators in most NSW-based public universities.

These examples of public financial investments in accelerators provide supporting evidence that policymakers see accelerators as critical for entrepreneurial clusters that help the economy develop and grow (e.g., Audretsch and Belitski 2017). Likewise, Van Hove, Vanaelst, and Wright (2018, 141) note that prior to the emergence of accelerators "high-potential ventures [were] co-produced through a myriad of usually uncoordinated interactions between different stakeholders," suggesting a need for a more coordinated and publicly funded approach.

> "The relationship between entrepreneurs and their communities is a relatively neglected topic in entrepreneurship literature. Yet, entrepreneurship does not take place in a vacuum, nor is it restricted to relationships between entrepreneurs and their customers, suppliers, investor, partners, and competitors. The actions of entrepreneurs can have both productive (e.g., job and wealth creation) and unproductive (e.g., unhealthy competition and environmental degradation) impacts on communities. Similarly, the policies and initiatives adopted by communities can be both helpful (e.g., infrastructure provision and maintenance, financial and nonfinancial programs to assist entrepreneurs) and detrimental (e.g., ill-conceived regulation and well-meaning but poorly designed market intervention) to entrepreneurs" (Lyons et al. 2012, 1).

This review of what the literature has uncovered in terms of the mission, operation, and impact of accelerators on start-ups and entrepreneurial ecosystems is quite promising, particularly in terms of its implications for their potential role as a critical element of the start-up infrastructure. However, there seems to be some paucity in terms of empirical studies and theoretical insights into the process by which these novel organizations might facilitate the functioning of entrepreneurial clusters. This is the key motivation for this study and what we learn by studying how the local accelerators facilitate the effective functioning of the Australian entrepreneurial ecosystem.

4 Methodology

In trying to accomplish the aforementioned research objective, the present study presents analyses of three distinct but interrelated studies. The first study involves analysis of semi-structured interviews from 11 accelerators about their origins and objectives. These interviews were conducted between October 2013 and March 2014, at the cusp of the Australian accelerator industry maturing. At the time approximately 20 accelerators were known to the team. Each interview lasted between 40 and 120 minutes and resulted in approximately 2140 quotes, 130 pages of single-spaced transcripts with approximately 106,000 words.

Australia was chosen as the research site due to access to the research participants through prior professional relations, and because of the perfect timing of the emergence of this young industry. By interviewing the founders of pioneering accelerators, we gain an extremely rich picture of the design and purpose of each accelerator. In retrospect, approximately 40 organizations existed nationally that could have been identifiable as accelerators (or at least as incubators or pre-accelerators), compared to the 160 known to the research team today; more than reported by any other researchers or other reports of Australian accelerators.

The second study involves analysis of structured interviews of 13 Australian accelerators and five other support organizations about their operational model and performance metrics. This third study includes a survey of 76 start-ups; 44 that participated in these accelerators and 32 start-ups outside the accelerators. The start-up survey assists in triangulating the claims made by accelerator operators about their impact on the cluster.

4.1 Accelerators as Providers of Community Capital

First, to explore the impact of accelerators at the level of the community or cluster and to deepen the conceptual analogy of accelerators as infrastructure we draw on Emery and Flora's (2006) Community Capital Framework. The CCF was developed to better understand a community's fundamental building blocks for economic development and includes seven forms of capital: (1) built; (2) cultural; (3) financial; (4) human; (5) political; (6) social; and (7) natural capitals. The CCF approach assists in identifying the entrepreneurial potential of a specific context, cluster or region (Asitik, Sharpley, and Phelan 2016).

Drawing on 6 of the capitals in the CCF, we can reinterpret the defining features of accelerators as manifestations of these capitals, as represented in Table One. We omit the Natural Capital from the CCF, as this is not represented within accelerators.

=== Table One About Here ===

These links between Community Capitals and accelerators' key features enable exploring how the capitals are interrelated to form a virtuous cycle of reinforcing capital development.

Second, to explore the prevalence of each of the capitals in the design and evolution of accelerators, we analyzed the transcripts of interviews with 11 accelerator founders about the origins, history, and evolution of their accelerator. Three leading questions were asked

about (i) their career leading into founding the accelerator, (ii) the genesis of the accelerator and its initial design, and (iii) its evolution since then. Searching the entire interview corpus for keywords and phrases related to the CCF resulted in the following distribution of quotes, which were analyzed further with regard to each Community Capital and their combination:

=== Table Two About Here ===

Considering that approximately half the quotes in the interviews are the questions by the researchers, the percentage of the participants' quotes with these keywords is quite likely much higher. The relatively high frequency of occurrences involving Community Capitals confirms that Community Capital and thus infrastructure is an essential attribute of accelerators. Illustrative examples of each of the capitals in the interviews include:

1. **Human Capital**: Human capital development is a core element of accelerators and manifested in their education program. The prevalence of this capital is also reflective of how inherent learning is to entrepreneurship. Until entrepreneurs have developed a scalable business model, they are constantly learning. The following quote illustrates the development of human capital for participants in the accelerator:

> "So, I think there's a whole bunch of skills and – but in two sort of very crude buckets; there would be the technical skill of your specialty – engineering, product management design, whatever it is, sales – and on the other side, it's just the entrepreneurship skill. [..] It's the entrepreneurial bit; that's the hardest. So we found [..] one of the developments from [our accelerator] was developing a reproducible way to train our teams to work like an entrepreneur, so that they're not – the biggest risk in our work is that it was – the previous management discipline of an entrepreneurship was do what you think is best as fast as you can and for as little money as possible. And – but what's emerged over the last five years is that actual management discipline – they're creating something new. And so, we found we didn't wanna leave it to chance and train people exclusively in their job but actually just take a great engineer, give them an initial set of training which we have accumulated over the years."

2. **Social Capital**: Another core element of accelerators is providing access to experts including mentors, guest speakers, and professional service providers. The following quotes illustrate the importance of social capital development in accelerators:

> "So, at that point we turned around and went, 'Okay, we get it. What really is an accelerated program? The value is not in the money, it's in the mentor network.' That's what everyone was saying, the mentor network in connecting with experienced people. So, we said, "Listen, why don't we just create this [accelerator]?"
>
> "So, I think there is the potential always for mentor fatigue and the way we get around that is – our program is very structured. And for mentors to come in, the minimum commitment for a mentor is to come in for one night and to talk to us for maybe 20 minutes and then take some Q and A but they're with us for three-ish hours. And that's a commitment. Some of them give a lot more than that but that's the minimum and there's quite a few mentors that we've had come, and they don't do much more than the minimum. And we're still able to achieve, I believe, high outcomes."

3. **Financial Capital**: Accelerators provide early-stage seed financing and referrals to follow-on capital. These forms of access to Financial Capital are illustrated in the following quote:

> "So, here's the most important metric of why people come to accelerators. The most, they do not come for acceleration. They don't. It's a hands down. We - I think, 36 out of our 36 CEOs said, "I didn't come here for the - for your acceleration. I came here for the money."

It must be noted that upon entry, many entrepreneurs assume the financial capital is the dominant capital provided. Meanwhile, upon graduation and reflecting on the process, the human and social capital were the dominant capitals valued by participants (see also Table 2 and 3 in Bliemel et al. 2016, consistent with Aspen Institute 2014, 6). The following quote hints at the interaction of capitals elaborated on later in this analysis; here, financial and social capital interacted via the external community of investors:

> "The good accelerator programs are experts at hitting data points that make you look like you're on the right path, so that you can hopefully raise money at the end. But that whole thing's predicated, therefore on a robust follow-on investment community."

4. **Political Capital**: In terms of governance, policies or power-relations, accelerator operators tend to provide the political capital up-front, during the selection process, and they reduce the political capital for participants once the cohort of start-ups is accepted to the accelerator. In addition to the standard terms of seed investment, the filtering and selection process represents enacted political capital, as illustrated clearly by one accelerator operator:

> That's part of our screening process. So, if you're not willing to share, forget it. And if you don't recognize the value of being around your peers, forget it. It's not gonna work. [Our screening process is] not formal at all, because every company is different. So, a lot of it is - so we meet. We can't do it in a form or Word document. You gotta meet someone and look at them in the eye and just see if you can - 'cause a lot of what our screening is doing is referring to our pattern recognition. [We] use this opportunity to set them some homework so see if they'll listen to what you're doing, so see if they're coachable. So, we always say, 'Tell us five things. Go away and answer these five questions.' A significant number never get back to us because the answers to those five questions are - they'd never thought about maybe asking Google about the 50 other companies that are doing exactly the same thing they're doing. And hopefully that might have saved them five years of their lives doing a really stupid idea. So, we do screen the people that way, but other people have tried the homework and they haven't succeeded. It also gives us that little bit of time to understand the strength of the team."

Once accepted into an accelerator the power-relations are managed differently, with some accelerators adopting relatively hierarchical relationships, and others adopting more of a democracy or holocracy, wherein entrepreneurs and mentors find their own match from within the pre-screened pools:

> "So, the commitment [by mentors] was, because of the way that we'd set up the actual matching for the mentor connect, it was, you promised to – the only real commitment was you promise to say yes or no as fast as possible. That you'll help the start-up, or you won't, and then beyond that we saw ourselves particularly for that program as kind of a matchmaker, not a relationship manager.

So, we'll do the matchmaking, and the system we had for doing that gave power to both sides to select."

"The founders have an opportunity to rate the mentors. The founders also have the opportunity to rate me as their facilitator and that means over the course of the various semesters, we're able to invite back the highly rated mentors at a greater rate than the lowly rated mentors."

5. **Cultural Capital**: Among others, a significant cultural aspect that the accelerator operators access and try and perpetuate is a culture of giving back to the next generation of entrepreneurs. The aims and challenges of maintaining this culture are aptly illustrated here:

> "So, the original core group, it was really this kind of this culture of giving back and just wanting to be around new and interesting ideas and trying to help. As we started to expand it and it started to expand too fast based on, we have this issue of – it just takes one exception. [..] There was a point, I couldn't tell you the date, a point in time where you could see the shifting of kind of these diversions between the traditional start-up people who really wanted to help and the others who had good experience, have never been engaged in the community though and just wanted [to put it on their LinkedIn profile] – saw start-ups were happening. [..] It's the worst of the group that kind of defines the group, not the best. And - anyway. Lessons learned. So, - yeah. The main motivation was - some people wanted access to deal flow, but really the main motivation for the good mentors was just this start up culture thing of, 'I'll give back, I just wanna help, it was tough for me, I wanna make it easier for you.'"

Instilling a sense of community and peer support also extended to the greater cluster in which the accelerator was located:

> "It's all about this movement that's starting about actually trying to highlight what actually does happen in [this city]. And a lot of people in [this city] don't know what happens in [this city]. So, it was a good way of providing that sort of information. It's also a good way of letting people know that successful [locals] are actually quite keen to give back and this was one way for them to give back."

6. **Built Capital**: The built environment of accelerators was usually the open plan office spaces provided for the entrepreneurs. While affordable office space was a key element that supported the other elements, it alone was not a selling feature to entrepreneurs. As illustrated in the following quote, as long as start-ups met in the

designated space for the structured program and mentoring sessions, they could remain in whichever offices they were already in:

> "I think a lot [of accelerators] probably don't [add value]. And some people will say, 'An incubator is where you come and get a bit of money, it's full time, you get office space, you work together, maybe you share some resources.' And then accelerators .. I guess the reason why we use the word accelerator is because we are part-time, although there are full-time accelerators, we don't provide all those other resources even though there are some accelerators who do that. And we genuinely try in that 14-week period to help you get from zero up 'til; I don't know, four, three. So, we try to help push you along that process."

Meanwhile, the majority of accelerator operators were keenly conscious of the spillover effects of being co-located within an incubator or co-working space, as illustrated in this quote:

> "There's definitely power in being located within the incubator and having that environment around you as well. So, I think apart from [Accelerator 1] and [Accelerator 2] and [Accelerator 3], we've got 47 companies in [the incubator] at the moment, employing about 300 people. So, there's a lot going on and there's the learnings that you can draw on from those companies as well."

Multiple integrated capitals: More telling than the frequency of individual types of Community Capital is the frequency by which quotes related to multiple Community Capitals. The frequent occurrence of quotes with multiple capitals reveals how fully integrated the capitals are and indicates how accelerator operators offer a coherent and cohesive offering to foster a virtuous cycle. This is illustrated well in the following:

> "The incubator is the physical environment for the mentoring, the networking, the events that we have. So, we don't do the full-owning incubator where it's not like a [co-working space, where] you just pay a service and you can access the space. What we do is we have the physical environment, part of our investment is this environment we have shared; so, facilitating the mentoring. We have shared services and the network, and we get the Alumni for the team we created that's very, very powerful. And finally, venture capital; we have our own venture capital fund, a 10 million dollar [fund], which co-invests at the angel round."

Because of the high level of integration of the Community Capitals, it remains a challenge to visualize their interconnections. Instead of presenting a dense network, we lay them out in a more chronological sequence corresponding to the acceleration cycle. As such, Figure One proposes a virtuous cycle of interacting capitals that facilitate entrepreneurial activity and continue to generate Community Capital.

=== Figure One About Here ===

4.2 Accelerators as Infrastructure for the Cluster

To further validate the intentions of providing a self-reinforcing cycle for start-ups and the cluster made during the above semi-structured interviews, a follow-up study was conducted between August and December 2015. This follow-up study included two populations: (1) operators of accelerators; and (2) start-ups, both start-ups who were in an accelerator and 'independents' who were not in an accelerator. For accelerator operators, the study started with a structured interview targeted at a (non-random) sample of accelerator operators to pre-test a survey version of the interview, and to collect initial data about those accelerators. The survey phase involved inviting all nationally known accelerator operators (at the time of the study) to complete the accelerator survey. The accelerator surveys were structured to request detail about the five defining elements of accelerators. They could be completed online but were often completed with guidance in person or by phone to encourage participation and ensure clarity of the questions. The second study's semi-structured interviews were closed-ended questions about the five accelerator elements, such as

i. The level of seed funding and equity
ii. Whether participation was part-time or full-time
iii. The degree to which the program was structured
iv. Whether a cohort model was used vs. an on-demand model
v. Whether mentors were in-house, external or not included

The non-random judgment sample was created by listing organizations already known to the research team who exhibited elements of accelerators and was supplemented by searching the internet in each Australian Capital city using 'accelerator' as the search term. Invitations were sent to 41 organizations, of which 24 had a public profile that closely matched the above five defining accelerator elements; the other 17 organizations were complementary to, but not entirely within the scope of accelerators, pre-accelerators or incubators, and were invited to be inclusive of a broad range of infrastructure related to the supporting start-ups. Of the 24 accelerators, 13 participated. Five other support organizations participated, including co-working spaces, angel groups, and mentoring organizations that only had three or fewer of the five defining features of accelerators. These additional support organizations were included to enable comparing and contrasting types of organizations within the sample.

The infrastructure and services provided by the accelerators in the sample mapped well to the five defining features from the literature review and the initial study: (1) standardized seed funding, (2) time-boxed cohort-based entry and exit, (3) a structured program, (4) co-location, and (5) mentoring. Table Three reports the percentage of respondents in the study that exhibited these processes.

=== Table Three About Here ===

The above analysis of these elements in Section 4.1 focuses on the start-ups within the accelerator. However, a re-analysis of both interview data sets shows that they also have implications for stakeholders beyond the accelerator's walls, thereby extending our knowledge of accelerators' impact on the Community Capital in the greater ecosystem.

Standardized seed funding, all accelerators in the study offered start-ups standardized terms that were comparable with accelerators internationally (e.g., Clarysse,

Wright, and Van Hove 2015). This Financial Capital was sourced from venture funds, foundations, corporate sponsors, or mentors in the greater cluster and complemented by in-kind value through things like vouchers or credits with partners (e.g., Microsoft BizSpark; Amazon Web Services), legal services, or time later in a co-working space.

Time-boxed cohorts, all accelerators studied followed a time-boxed cohort process typical of many accelerator programs worldwide (Cohen and Hochberg 2014); an enabling factor for providing each of the Community Capitals. The application process engaged the broader cluster via community engagement and recruiting events run by the accelerator that reinforced their presence in the entrepreneurial cluster.

Programs were three to six months in duration, and almost always only one cohort per year; a form of Human Capital development. The program usually involved bringing in service providers and investors from the entrepreneurial cluster. There was also a strong emphasis on getting start-ups to spend time outside the accelerator networking to potential customers and others in the cluster. The Demo-Day also activated stakeholders in the greater cluster by presenting the graduating cohort as potential deals for follow-on investors and as role models for potential applicants for the next cohort. Four accelerators had additional Demo-Day road shows overseas, including Silicon Valley, New York City, London, and China.

Co-location, accelerators typically require a full-time commitment from the start-ups in a prescribed space (Physical Capital). Many accelerators kept their operating budget lean by hosting their cohort within a co-working space or incubator, where the start-ups benefited from being part of a larger community of peers.

Mentoring is a hallmark of accelerators and a combination of Human and Social Capital. The effort required to establish and maintain a high-quality network of mentors are

significant. In rural areas, fly-in-fly-out mentors often supplement local mentoring. Accelerators reported having between 10-60 active mentors, and up to 150 in total. Mentors are typically vetted through existing relationships or referrals, but mentor quality is variable. Mentors are typically interviewed to assure quality (see McKevitt and Marshall 2015). In many cases, alumni of the accelerators returned as mentors.

Each of the above lends further support to the premise that accelerators can create a virtuous cycle of Community Capital development, for the community within the accelerator, as well as for the community around the accelerator, i.e., the cluster.

4.3 Coordinated versus Uncoordinated Community Capitals for start-ups

The second sample of the 2015 study included accelerated and non-accelerated (aka 'independent') start-ups to explore the relative impact (if any) that accelerators had. The sample was collected using targeted (non-random convenience) techniques. Start-ups and founders of both types were identified via their Twitter handles, which were extracted from the portfolio pages of accelerators and snowballed from lists of 'Following' and 'Followers' within the same temporal and special context (Australian start-ups in the given month). This sample of accelerated and independent start-ups was snowballed further by using Twitter to invite them to participate publicly and re-tweet, thereby exposing their followers to an invitation to participate in the research project. From 368 tweets, 105 surveys were returned, of which 76 were usable: 44 were accelerated start-ups, while 32 were independent.

Due to the nature of the sampling frame, collecting a match of individual start-ups by age, industry, experience and other characteristics was impractical. However, the age distributions were almost identical for the supported and independent start-ups. On average start-ups were launched in the fourth quarter of 2012, and the median launch year was 2014. The experience distributions of both sets were also almost identical, with fifty-two percent of

accelerated respondents having started at least one start-up before and fifty-one percent of the independent respondents stating the same. Both cohorts exhibited an equally extremely broad range of niches they were targeting.

The 44 accelerated start-up respondents disclosed 11 categories of support they believed were the most helpful after graduating from the accelerator as summarized in Table Four. Out of 96 responses, training (Human Capital) came out on top and was under-rated upon application or entry. As one participant commented in their reflection of how valuable the training was: "What to do next - it can be overwhelming with so much to do, so knowing what next helped us to focus!" This pattern reflects recent work by Kasouf, Morrish, and Miles (2013) regarding a link between building entrepreneurial capabilities and self-efficacy and participating in an accelerator.

Mentors (Human and Social Capital) were highlighted by 43% of start-ups, followed by contacts (Social Capital) in general (27% of start-ups). Peers (representing Social, Human and Cultural Capital) were also significantly under-rated upon entry and marked as significant by 20% of start-ups. Taken together, this supports other studies' findings that the most immediate impact of accelerators is growing one's network and learning from that network (e.g., Cohen 2013). This positive development of Social and Human Capital is contingent on the Political and Cultural Capital provided by the accelerators within each cohort. Providing egalitarian access to each of these capitals is further supported by the equally egalitarian Financial Capital provided.

=== Table Four About Here ===

The findings from the start-up survey illustrate the importance of access to the cluster (e.g., via mentors and direct referrals) above the more functional processes of the accelerator (e.g., seed funding, co-location, time-boxed cohort-based entry and exit, and a structured

program). The relatively high ratings of each feature and their underlying capitals nonetheless reflects how tightly coupled the capitals are.

By and large, start-ups initially expected Financial Capital and undervalued the other capitals. Upon reflection, they still appreciated the Financial Capital but expressed greater gratitude for the other capitals. Had the start-ups only applied for seed capital by angels and not by accelerators, they might likely have missed out on this additional value. The facilitation of value creation by the accelerator is reflected in the survey responses regarding attainment of major milestones. While 100% (44/44) of the accelerated start-ups reported having recently achieved a major milestone, only 19% (6/32) of the independent start-ups reported having done so.

That said, the revenues, job growth rates and funding received were qualitatively comparable across samples, indicating that it is still possible to produce "high-potential ventures [..] through a myriad of usually uncoordinated interactions between different stakeholders" (Van Hove, Vanaelst, and Wright 2018, 141) and without acceleration. Nonetheless, the complete absence of other milestones indicates that independent start-ups may lack the Human Capital to recognize other forms of accomplishments and that they lack a like-minded cohort with whom to celebrate milestones and regularly inspire each other to aim higher.

5 Challenges to Creating Virtuous Cycles of Community Capital Development

The findings support the premise in the literature that accelerators are infrastructure for start-ups in entrepreneurial clusters. The above analysis elaborates on how accelerators can perpetuate a virtuous cycle of developing Community Capitals. However, it must be noted that the independencies between capitals can also inhibit such a virtuous cycle. If one of the capitals is lagging, it could cause the entire virtuous cycle to collapse into a vicious

one. For example, Richards (2002, 74) found that incubation or acceleration *without* strong access to community capital financial and human endowments is much less successful due to a dependence on the local community for follow-on investors and mentors:

> "Two of the most critical issues that incubators and accelerators face are that they ***cannot tie their start-ups into money***, and they ***can't connect them to people*** who are key in their industry who wish to take on mentoring roles. These will eventually be the two things that will kill your program if you can't come through" (emphasis added).

This insight is echoed by Barrehag et al. (2012) and Hochberg (2015). These connections can take years to develop and may require simultaneous development of all community capitals (see also Audretsch and Keilbach 2004; Emery and Flora 2006; Isenberg 2010). The interdependency between the accelerator and the greater cluster can also be vicious if there are insufficient capitals in the cluster for the accelerator to draw on. One of the most obvious deficiencies is a lack of venture capital, causing many start-ups to look overseas for venture capital, acquisition or public listing. A less obvious potential deficiency is the depth and breadth of the pool of mentors, with the risk of mentor fatigue or burn-out, as mentioned by one accelerator founder:

> "But it does get harder and harder in Australia and I think, as we get more and more accelerators, mentorship's a big problem to solve because we have run out of mentors, I think, so – I mean, for example, I could go out every night of the week and mentor people, and it just – I feel like I'm disappointing people all the time so I really want to support people, but I have to see my family at some stage [..] mentors are now being pulled every which way by so many different events that they can't do it and it's unrealistic. I just see the level of engagement drop. I see my own level of engagement drop. And especially as you start working on your own stuff, well then you have less time."

6 Limitations, Discussion and Policy Implications

The present study is limited by both the sampling design and the sample size. The sample is non-random, so the findings may not readily be generalized beyond the sample

itself or beyond Australia. The small population and sample sizes limit analysis to primarily qualitative and descriptive analysis.

Accelerators are found to exhibit the five defining elements found in earlier studies (Hochberg 2015; Miller and Bound 2011) and re-defined here, including: (1) seed funding; (2) time-boxed cohort-based entry and exit; (3) co-location; (4) a structured development program; and (5) mentoring. While, accelerators tend to use performance metrics such as follow-on funding, the revenues of start-ups, job creation, and exit valuation multiples to assess their operational performance; many of these come second to the importance of contributing to the longer-term development of the entrepreneurial cluster. It is also important to note that accelerators are often start-ups themselves constantly evolving (Bliemel et al. 2018), and thus changing how they function as start-up infrastructure for entrepreneurial clusters.

This study finds corroborating evidence across three distinct studies that accelerators can foster a virtuous cycle of developing human, financial, entrepreneurial, political, cultural and built Community Capitals. However, developing these is not without risks and can result in a vicious cycle. The cycle may tip from virtuous to vicious if one of the capitals develops out of synch with the others and if the accelerator cannot readily draw on the capitals in the greater cluster. This has policy implications in that multiple policies may need to be synchronized to cultivate a thriving community. For instance, focusing only on venture capital policy without simultaneously considering policies related to education, immigration, employee stock options, R&D tax credits may result in weakening the system.

Empirically, this study adds more texture to the discussion about how accelerators facilitate knowledge spillovers and create community capital. The interviews highlight the critical role that mentors play in continuously reinforcing the linkages between the accelerator and cluster and the role accelerator operators have in curating, selecting, filtering

and brokering those relationships. The coordination of the key elements of accelerators are instrumental to their own success and may also be instrumental to the cluster's sustained success and future development.

This study also extends work by Van de Ven (1993), Audretsch, Heger, and Veith's (2015), and Audretsch and Belitski (2017) to add empirical evidence to the claims that infrastructure development is endogenous to the entrepreneurial cluster. It also highlights that accelerators are active providers and developers of infrastructure by way of developing 6 of the Community Capitals in the CCF in a highly integrated manner. The authors hope that this paper stimulates additional work on accelerators as infrastructure for tech start-ups in entrepreneurial clusters and the endogenous nature of community capital in the entrepreneurial process.

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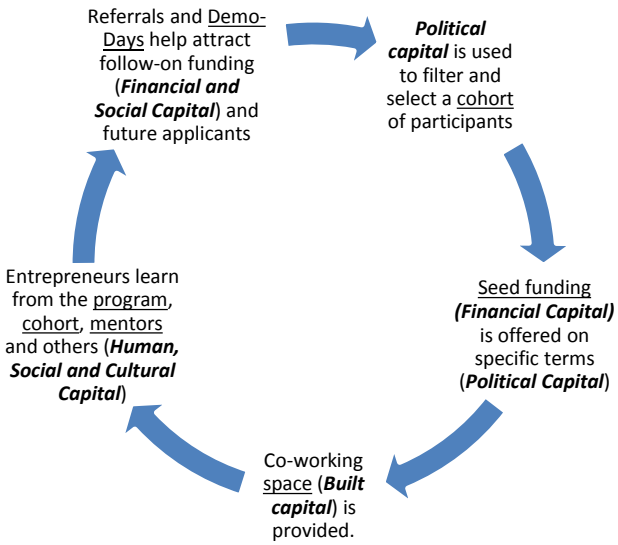
Figure One

A virtuous cycle of accelerators as generators of Community Capital[1]



[1] Bold italicized text denotes a Community Capital. Underlined text denotes the corresponding key element of accelerators

Table One: Community Capitals versus Accelerator Features

Community Capital[1]	**Accelerator feature and relation to infrastructure for entrepreneurial clusters**
Human	Developing skills and abilities from • Cohort-based learning from educational program speakers • Customized learning from mentors, accelerator managers, invited guests and alumni • Peer learning from co-located peers
Social	Developing connections to • Mentors, accelerator managers, speakers, and invited guests and alumni • Co-located peers • Referrals to external investors and other stakeholders
Financial	Accessing financial resources via • Seed funding the accelerator • Introductions to follow-on investors • Revenues from customers • Government grants
Political	Managing power-relationships within the accelerator via • Regulation of terms of entry & exit • Selection process for entry • Internal policies and processes • Screening process for referrals (e.g., to mentors and investors) Managing power-relationships outside the accelerator via • Supporting applications to public grants and regulatory organizations
Cultural	Establishing norms of behavior, traditions and shared language via • Cohort selection and screening process, including hosting public recruiting events and graduations (DemoDays) • Guidance from Mentors • Induction from educational programs • Interactions with co-located peers
Built	Sharing of physical resources via • Co-location in the same space provided by the accelerator and its immediate physical environment

[1] Adapted from Emery and Flora (2006)

Table Two: Occurrences of Community Capitals in the Corpus

Community Capital (and keywords in transcript) [1]	**Quotes with Occurrences** (% of quotes)[2]
Human ("skill," "capability*," "_abilit*,[3]" "competen*," "learn")	79 (4%)
Social ("social," "network," "relation," "connect," "refer*," "introd*")	117 (5%)
Financial ("invest," "fund," "bank," "cash," "revenue," "money")	316 (15%)
Political ("rule," "regulat*," "term," "power," "select*," "screen," "govern*")	137 (6%)
Cultural ("cultur*", "norm", "tradition*", "communit*")	67 (3%)
Built ("space," "built," "physical," "infrastruc*")	102 (5%)
Multiple capitals within the same quote	574 (27%)

[1] Searching for singular included plurals. Asterisk denotes searching for any combination of characters beyond the base string.
[2] Occurrences are not mutually exclusive to each type of capital, as evidenced by the high incidence of quotes involving multiple Community Capitals
[3] A blank character before this string eliminated false positives for words like 'availability' or 'probability' or duplicates of 'capability.'

Table Three:

Characteristics of Australian accelerators and similar support organizations

Key element of accelerators	**Proportion of sample with that element[1] (n=18)**
Mentoring	82%
Time-boxed cohort-based entry and exit	76%
Co-location	64%
Seed funding	64%
Structured development program	47%

[1] Includes 13 accelerators and 5 related support organizations

Table Four:

Aspects of accelerators deemed most helpful by graduates

Processes with the greatest impact	**Proportion of start-ups mentioning that reason**
Access to training and educational program	45%
Access to mentors	43%
Contacts, networking, and access to the ecosystem	27%
Access to a group of peers	20%
Access to the accelerator's seed equity	18%
Access to an office space	18%
Access to technical support	16%
Access to investors	14%
Access to media and PR	11%
The accelerator's operators' reputation	2%
Interactions with the government	2%