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RESEARCH ON TECHNOLOGY ENTREPRENEURSHIP AND ACCELERATORS

Essays on the emerging phenomenon of accelerators across Europe

PhD Dissertation

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EXECUTIVE SUMMARY

The last few years, accelerators are quickly proliferating across the globe. To illustrate, the F6S-platform for founders indicates that the worldwide number of accelerators has grown from 194 in 2012 to 793 in 2015; an increase of 308%. However, there is quite some confusion about what an accelerator is and what its impact is on early-stage technology ventures. To add to the confusion, many programs are continuously evolving their models. Understanding the organizational design of accelerators, its effectiveness, and its role in the startup ecosystem is key if we want to properly advise policy makers, investors, and corporates looking for new ways to spur the development of innovative ventures. Furthermore, focusing on accelerators provides an opportunity to extend the learning and experimentation literature as it offers a natural lab setting. Accordingly, the overarching research question of this dissertation is: *what do accelerators do and how do they impact the entrepreneurial trajectory of ventures*?

This study uses theory elaboration methods to suggest how accelerators are configured and what happens within an accelerator program. The research setting is 40 accelerators across Europe—cohort-based startup support programs that accelerate learning and are seen as problem solvers for various actors in the entrepreneurial ecosystem such as venture capitalists, governments, corporates and even incubators. For instance, setting up an accelerator benefits venture capitalists by facilitating investments in a larger number of early-stage ventures at relatively low cost. It also benefits governments and corporates to streamline technology commercialization efforts.

Thus, accelerators are an important phenomenon and this study provides several insights. On the one hand, it opens the 'black box' by highlighting the design and practices of the accelerator. By recognizing the heterogeneity among accelerators, it is clear that more robust metrics have to be developed in order to monitor the effectiveness of the different models. Although classifications of accelerator programs based on their relative performance (e.g. the Seed Accelerators Ranking Project) could be of importance to startups, it may also provide a distorted view considering programs can differ in their strategic objectives.

On the other hand, it explains to policy makers, accelerators and early-stage technology ventures the boundary conditions of acceleration. First, policy makers need to take a long-term budget view when they consider to support startups through accelerator programs. Second, many ventures may not be investor-ready or commercially viable at the end of an accelerator program. Therefore, a systematic policy approach is needed for startups to thrive. Third, both

early-stage technology ventures and individuals interested in setting up an accelerator should take into account the specific program components such as the selection process and the learning approach when respectively considering to apply for a program or configure one.

Taken together, these essays demonstrate that accelerators occur in various forms, are constantly evolving and can differently impact the development of early-stage ventures.

SAMENVATTING

Het aantal accelerators is de laatste jaren snel gegroeid. Zo toont het F6S-platform voor ondernemers dat het wereldwijd aantal van accelerators gegroeid is van 194 in 2012 tot 793 in 2015. Dit is een stijging van 308%. Niettemin, er is nog steeds veel onduidelijkheid over wat een accelerator is en of dit middel wel effectief is in het helpen van technologische startups. Daarbovenop zijn acceleratoren hun programma continu aan het veranderen aangezien ze "on the job" leren wat werkt en wat niet werkt. Meer inzichten in de configuratie van acceleratoren, hun invloed op het succes van de startup, en de rol die ze spelen in het startup ecosysteem is noodzakelijk indien we de politiek, investeerders en bedrijven willen adviseren in hun zoektocht naar middelen om jonge technologische bedrijven te stimuleren. Daarbovenop, een accelerator programma is een natuurlijke setting om het debat rond de 'learning' en 'experimentation' literatuur verder te zetten. De hoofdvraag van dit proefschrift luidt daarmee: *wat doen acceleratoren en hoe dragen ze bij aan de prestaties van startups?*

Deze studie gebruikt specifieke theoretische methodes met het doel verklaringen te zoeken over hoe acceleratoren geconfigureerd zijn alsook te belichten wat er in feite gebeurt tijdens een accelerator programma. Dit proefschrift analyseert informatie die gecollecteerd is van 40 acceleratoren gebaseerd in Europa. Acceleratoren zijn cohort-gebaseerde programmas die het leren van de startups versnellen alsook traditionele problemen oplossen voor verschillende actoren in het startup ecosysteem. Bijvoorbeeld, een accelerator opzetten kan voordelen met zich meebrengen voor investeerders zoals het faciliteren van investeringen in een groter aantal startups voor een relatief lagere kost. Het bevoordeelt ook regeringen en bedrijven in hun inspanningen voor technologieën op de market te brengen.

Accelerators zijn dus een belangrijk fenomeen en dit proefschrift geeft verschillende inzichten aan de lezer. Langs de ene kant, opent deze studie de 'black box' door de configuratie en de praktijken van de accelerator te verkennen. Aangezien er duidelijke verschillen te vinden zijn tussen acceleratoren, is het noodzakelijk om betere maatstaven te ontwikkelen om de invloed van de verschillende acceleratoren te evalueren. Alhoewel er hedendaags verscheidene classificaties terug te vinden zijn die acceleratoren evalueren gebaseerd op standaard prestatie metingen (bv. Seed Accelerators Ranking Project), geeft dit meestal een vervormd beeld.

Aan de andere kant, wordt er in dit proefschrift gekeken naar de randvoorwaarden van startup acceleratie. Ten eerste, beleidsmakers moeten een lange termijnvisie uit tekenen betreffende het budget om acceleratoren te subsidiëren. Ten tweede, het is mogelijk dat startups

die doorheen een accelerator gegaan zijn, nog steeds niet matuur of aantrekkelijk genoeg zijn om een volgende investering op te halen. Het is daarom essentieel om een systematisch beleid te ontwikkelen om te verzekeren dat startups succesvol worden. Ten derde, jonge technologische bedrijven alsook diegene geïnteresseerd in het opzetten van een programma moeten rekening houden met de specifieke programma componenten van een accelerator zoals het selectie proces alsook de leer methodes die toegepast worden.

De bevindingen van dit proefschrift demonstreren dat acceleratoren constant evolueren, verschillen in termen van de configuratie en de invloed die ze hebben op het succes van de startup.

CONTENT

INTRODUCTION TO THE DISSERTATION

In recent years, the number of technology startups has seen a major growth worldwide. A combination of cloud computing platforms, programming frameworks, code sharing, APIs, easily accessible marketing platforms, distribution channels, social media networking, 3D printing processes etc. have lowered barriers to creating a technology startup. This commodity technology stack resulted in both the fundamental democratization of entrepreneurship but also (even) more substantial variation in startup quality.

As a result, the topic of technology entrepreneurship has increasingly attracted the interest of researchers and policy makers who recognize its positive effect on economic development. Prior work has defined technology entrepreneurship as a multidimensional concept—technological innovation and entrepreneurship—that involves a variety of actors and different levels of analysis (Mosey, Guerrero & Greenman, 2017; Shane & Venkataraman, 2003). New technology ventures typically face a plethora of challenges as the founding and development process often appears complex, compressed in time and uncertain in its outcomes. Consequently, many organizing attempts fail (Yang & Aldrich, 2016) due to the liability of newness.

However, entrepreneurial efforts can be stimulated (or hampered) by numerous contextual factors (e.g. Suddaby, Bruton & Si, 2015). Researchers need to both consider entrepreneurial actions and how well the context supports the transformations of these efforts into real-life businesses when investigating technology entrepreneurship (cf. De Massis, Kotlar, Wright & Kellermans, 2017). For instance, there are currently all sorts of startup support models that spread the "know-how" of doing a startup, decentralizing tech creation and making the processes more accessible and uniform. Aiming to tackle the issue of liability of newness, many university, corporate, entrepreneurial and government actors attempt to devise these startup support programs.

The ultimate goal of these programs is to create the right founding conditions that lower the risk of failure for entrepreneurs and spur economic activity. Besides more standard approaches such as co-working spaces or makerspaces that focus on the provision of space or machinery to prototype, we have witnessed an evolution of incubation approaches such as incubators and accelerators over the past decades. Prior work suggests that these incubation models are the foremost platforms and drivers of technology entrepreneurship (Tornatzky,

Sherman & Adkins, 2003; Audretsch, 2007). In this study, I focus mainly on the latest generation incubation model, the accelerator.

The introductory chapter is organized as follows. We start surveying the literature discussing the evolution of incubation models. Next, I present the latest generation of incubation models, the accelerator and how it is configured and what the latest trends are. This provides the basis for the remainder thesis chapters. Finally, I describe the overarching research question and craft the individual research questions that motivated each study. This is followed up by the research design and why I believe a qualitative approach was essential to investigate the phenomenon of accelerators.

INCUBATOR DIVERSITY

Ambitious, innovative startups are a key source of economic growth. For instance, previous Nesta research shows that just 6% of fast-growing UK businesses generate the lion's share of employment growth in the UK (Bone, Allen & Haley, 2017). While these high-growth businesses can be found across all sectors and in all stages of the business lifecycle, new technology startups are a significant part of this group. From the existing body of research, we know that technology startups often face a number of challenges or major hurdling blocks when they start out. For example, startups might struggle because of limited financial resources (Smilor, 1987), a lack of startup experience in the founding team (Gruber, MacMillan & Thompson, 2008; Wright & Vanaelst, 2009), a lack of legitimacy to attract good employees (Zott & Huy, 2007) or a lack of knowledge or understanding of how to seize certain opportunities (Ambos & Birkinshaw, 2010).

Over the past decades, a range of incubation models have evolved to meet these needs, backed by policy makers, private investors, universities, and corporates. Defined as organizational sponsors, open-system orchestrators and institutional intermediaries, they help mediate the relationship between startups and their environments by providing resources intended to increase investor readiness and venture survival rates (cf. Clayton, Feldman & Lowe, 2018; Ameczua, Grimes, Bradley & Wiklund, 2013; Giudici, Reinmoeller & Ravasi, 2017; Armanios, Eesley, Li & Eisenhardt, 2017).

Evolution of incubation models

Incubators became widespread in the early 90s (Hackett & Dilts, 2004), providing support for small ventures such as physical space, consulting services, assistance in finding suppliers and distributors, and sometimes financial resources (Allen & McCluskey, 1990; Aernoudt, 2004).

Perceived as an economic development tool and a property-based organization, it is configured to accelerate the growth and success of entrepreneurial companies through an array of business support services and resources (Phan, Siegel & Wright, 2005). They are typically operated by a variety of private and public actors including government agencies and NGOs and vary in terms of their engagement with incubatees – from a laissez-faire to a strong intervention regime (Bergek & Norman, 2008). Overall, the rate of incubated firm survival may be as high as 80 percent compared to non-incubated firms (Hackett & Dilts, 2004; Peters, Rice & Sundararajan, 2004). However, as impact studies use different methodological approaches and focus on different venture outcomes, the empirical evidence about the general effectiveness of business incubation is mixed. For instance, incubators have been criticized over the years for its lack of exit policy (Bruneel, Ratinho, Clarysse, & Groen, 2012) and its reliance on long-term public funding to be sustainable.

Whereas the first incubators focused primarily on providing infrastructure, the nature of incubators changed by augmenting the initial offer with business support services and access to networks. Due to the changing nature of incubation models, today's business incubator landscape appears largely heterogeneous in terms of the value proposition and model. For instance, the heterogeneity of services provided and the type of innovation generated gave rise to different types of incubation models (Grimaldi & Grandi, 2005; Barbero, Casillas, Wright & Garcia, 2014).

Notably, when incubators emerged, many of the innovative technology startups were active in sectors such as biotechnology, micro-electronics and electrical equipment which are typically capital intensive (Wright, Clarysse, Mustar & Lockett, 2007). However, advances in technology and the rise of the digital economy has changed the landscape in which many startups operate, rapidly reducing the costs and time taken to bring a product or service to market. As incubators evolve their strategy and service offering to adjust to the needs of the startups (Bruneel et al., 2012; Mian, Wadide & Fayolle, 2016), a new incubation model was created to assist these new digital ventures early in their lifecycle i.e. accelerators (Birdsall, Jones, Lee, Somerset & Takaki, 2013; Hochberg 2016; Kupp, Marval & Borchers, 2017). It is considered to be the latest generation of incubators in which the focus is even less on space and more on assisting the ventures through their entrepreneurial journey (see Study 1). Accelerators are basically innovative investment vehicles and business service providers, which select promising entrepreneurial teams and tend to provide them with pre-seed investment and time-limited support comprising formal education and intensive mentoring

(Clarysse, Wright & Van Hove, 2014). Using the lean startup approach, it primarily aims to improve overall venture performance and increase their investment chances in a rapid manner.

Cohen (2013) defines accelerators as fixed-term, cohort-based programs, including mentorship and educational components, that culminates in a public pitch event, often referred to as a 'demo-day'. Some provide stipends or seed investment and receive an equity stake in the portfolio venture in return (on average between 5 – 10%). The capital provided typically runs from $25,000 to $150,000 and is offered at the very earliest stages. Accelerators also differ substantially from typical incubators that were created for capital-intensive startups or formal IP-based technology spin-offs. First, they are primarily not designed to provide physical resources or office support services, and second, they are less focused on venture capitalists as the next step of finance, but are more closely connected to business angels and small-scale individual investors. Prior work pointed out the operational differences by describing incubators as "startup gyms" and accelerators as "startup boot camps" that are equipped as incubators, but typically have a more defined mission, application process, cohorts entering and exiting programs together, methodology for progress, and stakeholders (Deering, 2014:13; Cohen, 2013).

Overall, the uniqueness of accelerators compared to other startup support initiatives is the concept of accelerated learning which can be defined as "learning that happens faster than it would under typical conditions" (Cohen, 2013:18). Along these lines, I define accelerators in this study as cohort-based programs that provide relatively short-term support, certify the value and accelerate the learning of new technology ventures (cf. Kim & Wagman, 2014; Hochberg, 2016; Pauwels, Clarysse, Wright & Van Hove, 2016).

Startup accelerators

Startup accelerators have taken the world by storm. Pioneered by Paul Graham and Jessica Livingstone in 2005 with Y Combinator, they have grown into an industry of its own. Brad Feld, cofounder of Techstars – one of the earliest U.S. accelerators – even speaks of an "*accelerator movement*" that has fundamentally changed the way companies are created. It is set up to assist startups in developing their product (or service), in strengthening their team, fine-tuning components of the business model in order to become investment-ready. The surge in programs can be explained by the rapidly evolving digital infrastructures (Sofia, 2016; Autio, Nambisan, Thomas & Wright, 2017) and the massive flow of capital into the software industry.

The rapid evolving digital infrastructures can be explained by increased modularization of products and services in the software industry and a global internationalization push creating a new economy of 'third party software foundries' (Nowak & Grantham, 2000; Altman, Nagle & Tushman, 2015). Miller and Bound (2011) have attributed these "new economics of startups" to considerably lower costs of technology development and market learning activities because of easier access to customers and easier routes to revenue. In fact, the word 'startup incubation' became even strongly related to startup support organizations that develop internet-based ventures (cf. Hansen, Chesbrough, Nohria & Sull, 2000). In other words, startup accelerators are a digital economy phenomenon and are organized around the entrepreneurial opportunity discovery and the pursuit of new technology ventures that are predominantly offering some form of software and internet services (Fedher, 2016; Cohen, 2013; Konczal, 2013).

The massive flow of capital relates to the concentrated activity of investors on sectors of information technology (NVCA, 2016; 2017) because they are deemed capital-efficient for "*both experimentation and subsequent scaling that can generate large returns for the successful investments in a short period of time*" (Kerr, Nanda & Rhodes-Kropf, 2014:33). This combined with the wish of early-stage investors to invest in a wide variety of early-stage ventures at relatively low cost is consistent with the operational concept of accelerators (Shane, 2016). Accelerators basically provide the opportunity for investors by acting as investment vehicles to mitigate risks linked to early-stage investments and by identifying and evaluating potential investments (Hochberg, 2016). In other words, it can serve a dual function as "deal sorters and deal aggregators" for investors (Fedher, 2016:20). Some even describe accelerators as spray and pray models that fund primarily internet startups (Adkins, 2011). To illustrate, on the FAQ webpage of every Techstars accelerator program it is emphasized that they fund "*web-based or other software companies… and do not fund biotechnology companies*"[1].

Thus, the convergence of factors in information technology and capital markets has contributed to the wave of accelerator programs spreading across the world. To illustrate, my fieldwork indicates that main European cities i.e. London, Berlin, and Paris host currently upward of 115 active accelerators, an increase of more than 50% compared to 2015. Fig.1 documents the total number of Berlin, Paris and London-based programs meeting the formal definition of "accelerator" (see defined above). It maps the programs by year of founding.

[1] https://www.techstars.com/programs/ (last consulted on 01/12/2017).

While the proliferation of these "professional training systems"[2] is clearly evident, evidence on the role and efficacy of these programs are scant at best. Recent research suggests that accelerators are meaningful in different ways: speeding up the learning process of startup teams (Hallen, Bingham & Cohen, 2014) at a lower cost; enhancing the social capital of founder teams (Cohen, 2013; Radojevich-Kelley & Hoffman, 2012); accelerating the time to raise venture capital and reaching high-level traction (Gonzalez-Uribe & Leatherbee, 2017; Hallen et al., 2014; Roberts & Kempner, 2017); and certifying startup quality (Kim & Wagman, 2012).

These effects have also been echoed in popular press which argues that the impact of accelerators on admitted ventures can be explained by a conducive environment that pushes ventures in "a constant state of learning and pivoting to get it right"[3]. Notably, by playing a key role in supporting startups, accelerators seem to foster the entrepreneurial ecosystem generating more seed and early-stage financing activities (Hochberg, 2016; Goswami, Mitchell & Bhagavatula, 2017; Armanios et al., 2017; Porat, 2014). In sum, accelerators seem to have a positive impact on the entrepreneurial trajectory of ventures albeit the effect varies widely because of the heterogeneity of accelerators.

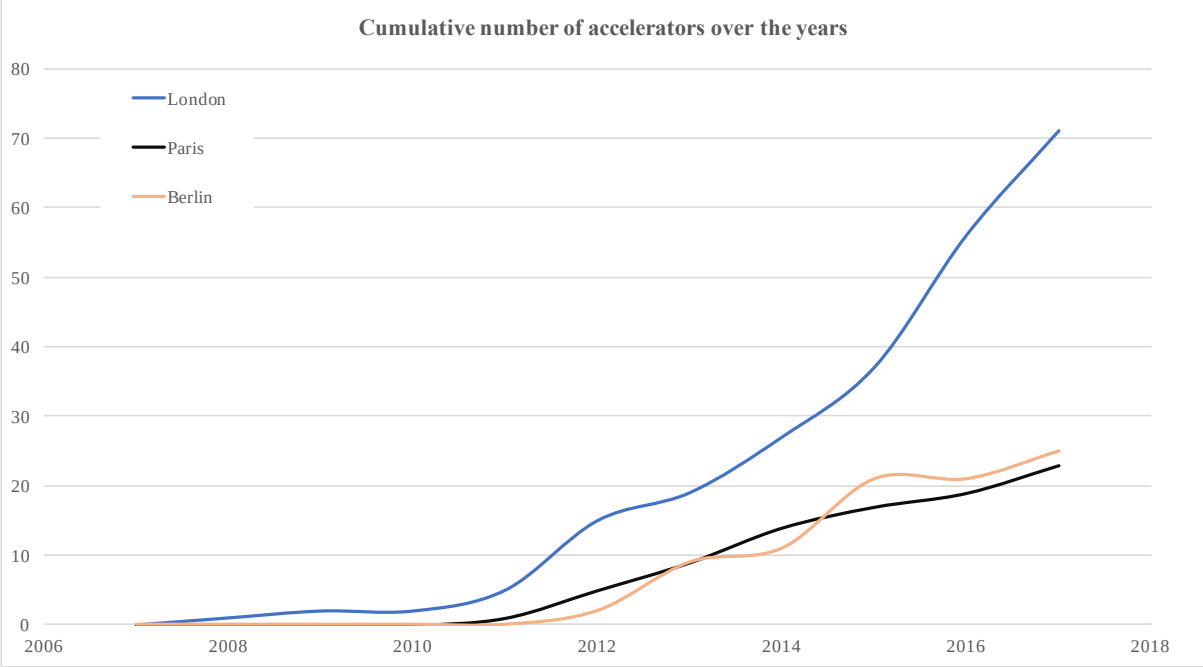

Figure 1. Number of accelerator programs meeting the formal definition of "accelerator" over time, based in three main European cities i.e. London (blue line), Paris (black line) and Berlin (orange line).

[2] Article: https://www.economist.com/news/special-report/21593592-biggest-professional-training-system-you-have-never-heard-getting-up-speed (last consulted on 01/12/2017).
[3] Article: https://www.fa-mag.com/news/inside-tour-for-advisors-of-a-major-fintech-accelerator-28019.html (last consulted on 01/12/2017).

Similar to the changing nature of incubators over time, the accelerator landscape has been evolving ever since as accelerators are still experimenting how to effectively accelerate startups. I have identified 3 emerging trends which may further affect the entrepreneurial environment in years to come.

Emerging trends

A. Demise of the Demo Day

The typical accelerator celebrates the end of the fixed-time program with a signature event commonly known as "Demo Day" or "Investor Day". This is an opportunity for accelerated ventures to pitch upon graduation in front of many prestigious national and foreign investors to raise money. However, the importance (and format) of demo day is an ongoing discussion at accelerators and while still important, it may not be the most effective path of follow-on funding (e.g. Curk, 2017). This is echoed in popular press[4] and seconded by Bone and colleagues (2017) who pointed out that only 17% of UK-based accelerators are hosting demo days. The main criticism is that investments happen because of relationships and not the pitch itself. Overall, it seems that accelerators move past such events and focus more on building one-on-one relationships between investors and portfolio ventures.

B. Verticalization and Corporate Programs

The first accelerators generically targeted internet-related startups instead of focusing on specific industries (Cohen, 2013). Even though organizations such as Global Accelerator Network champion a 'one size fits all' approach to accelerate ventures, new models are emerging. To illustrate, there is a growth of vertical programs focused on fast-growing technology sectors such as Fintech, digital health, energy etc. Specialization in a specific industry allows programs to establish a brand within a particular ecosystem, to attract domain experts, to develop a core competence, and to respond to calls of corporate clients within the industry of interest (e.g. Goswami et al., 2017). The latter also highlights the change in funding sources for accelerators.

While venture capital funds were initially responsible for most of the early accelerators (especially in U.S.), this has now changed considerably. For instance, corporates started to adopt this organizational form as a new method to foster collaborations between startups in order to gain access to talent and innovations (e.g. Bonzom & Netessine, 2016; Bone et al., 2017; Richter, Jackson & Schildhauer, 2018). Prior research suggests that accelerators can be

[4] Article: https://techcrunch.com/2017/03/04/why-were-ditching-demo-days/ (last consulted on 01/12/2017).

used as a catalyst by incumbent organizations to 'mobilize' their own ecosystem (Sivonen, Borella, Thomas & Sharapov, 2015; Weiblen & Chesbrough, 2015). In other words, it is an undertaking to attract, fund, accelerate and launch startups as part of a corporate's ecosystem. An example is the accelerator program Fintech Innovation Lab powered by Accenture. It is focused on companies developing innovative and commercially-focused applications for the financial service industry. In 2012, this 12 week equity-free program delivers business mentorship from financial service executives and investors. Although it will not deliver direct operating profits to the sponsoring firm(s), it allows to strategically explore new opportunities. For instance, Figure 2 exemplifies this trend by visualizing the growth of corporate accelerators relative to the total number in the entrepreneurial ecosystem of London.

Furthermore, universities, like many local governments, have glommed onto the accelerator trend, opening programs to streamline their technology commercialization efforts as well as facilitate students' entrepreneurial aspirations (Byrd, Herskowitz, Aloise, Nye, Rao & Reuther, 2017; Wright, Siegel & Mustar, 2017).

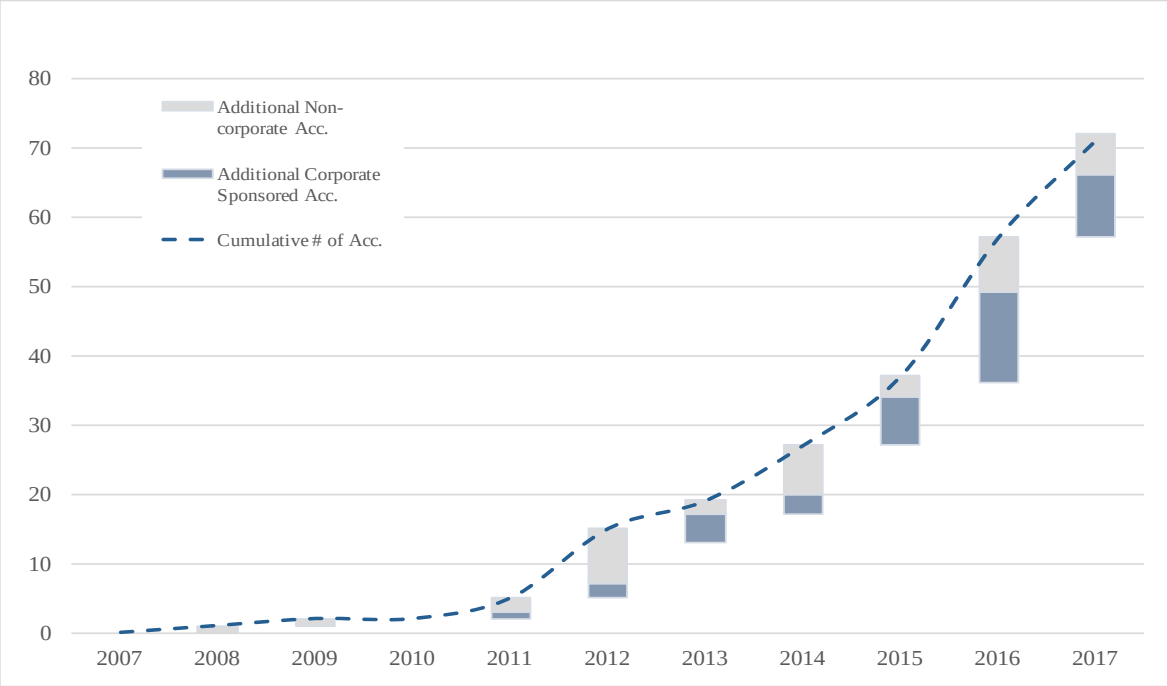

Figure 2. Number of London-based accelerator programs meeting the formal definition of "accelerator" over time. The figure indicates the undeniable trend of the rise of corporate accelerators (colored in grey) relative to other types of accelerators

C. Diversification in Revenue Streams and Startup Type

Described as an alternative source of entrepreneurial finance (Drover, Besenitz, Matusik, Townsend, Anglin & Dushnitsky, 2017; Bernthal, 2016) that invest in cohorts of startups, accelerators more often base their business model on equity from startups. The 'cash-for-

equity' model provides an opportunity for investors to structure investments in startups as real options which provide the right, but not the obligation, to make future investments. It is also an efficient way to find promising companies in places where investors do not have a network of contacts (Shane, 2016). It is an arrangement developed mainly for software and mobile ventures because they have a rather short exit horizon compared to science-based ventures. Nevertheless, to rely on exits requires developed exit markets (and therefore a suitable institutional setting). Due to the relatively long-term strategy and the relatively small number of exits, some accelerators were urged to change the 'cash-for-equity' model and explore new revenue streams to cover the operational costs (Brunet, Grof & Izquierdo, 2017). Examples of alternative revenue streams are subletting office space, hosting events, developing paid learning programs and rethinking corporate innovation by extending their services to corporations. To illustrate, Techstars and other accelerators partner on a global scale with major corporations such as Disney to create corporate accelerator programs for each company. Besides the 'mercenary' accelerator model, CoLab spaces are launched which aim to connect startups with incumbents to promote proof-of-concept projects e.g. Startupbootcamp's Rainmaking Colab[5].

In addition to the diversification of revenue streams, accelerators started to admit different types of ventures. While initial accelerator programs focused primarily on startups producing software and mobile services, the last years have seen an increasing number of programs developing a more heterogeneous venture portfolio as well as those specifically designed for science-based ventures, such as for example technology-oriented spin-offs from universities. For instance, Microsoft Accelerator recently shifted its focus from early-stage to late-stage startups since its debut in 2012[6] while Y Combinator admitted in its summer batch 2017 science-based ventures that build an outdoor farming robot, a sonar bracelet for visually impaired individuals and a self-driving personal aircraft[7].

PROBLEM STATEMENT AND RESEARCH QUESTIONS

While the business incubator concept has been practiced in the U.S. since 1959, it has only been since 2005 that accelerators have become an alternative, and their rapid ascent in popularity over the past decade has been striking. Based on the perceptual successes of U.S.-

[5] Article: http://www.bankingtech.com/1068712/rainmaking-colab-kicks-up-a-storm-for-fintech-innovation/ (last consulted on 01/12/2017).
[6] Article: https://telecom.economictimes.indiatimes.com/news/microsofts-zack-weisfeld-on-microsoft-accelerators-evolution-how-do-they-choose-startups-more/55866289 (last consulted on 01/12/2017).
[7] Article: https://techcrunch.com/2017/08/21/y-combinator-summer-2017/ (last consulted on 01/12/2017).

based accelerators such as Y Combinator and Techstars, various accelerators have been set up throughout Europe to assist technology ventures in their learning process and hence accelerate the process of finding the product-market fit and associated business model with the highest potential (Bruneel et al., 2012; Giudici et al., 2017; The Economist, 2014). They typically support startups which could benefit from low startup costs (Miller & Bound 2011) and hence train and mandate startups in entrepreneurial practices such as experimental learning mechanisms to test the market and find a product-market fit. However, despite the unique position of the accelerator, the literature tends to be a-theoretical and does not help us understand exactly how such organizational sponsors can contribute to the evolution path of entrepreneurial ventures.

To overcome these shortcomings and advance the understanding of accelerators, I set out to investigate the characteristics of accelerators and the internal processes that underlie how accelerators affect the entrepreneurial trajectory of ventures. For instance, are all accelerator programs using a standardized model to accelerate startups in a controlled manner? How do accelerated ventures refine their ideas and make progress over time? Overall, there is a great need for field research on what takes place within an accelerator's four walls. This thesis is divided into papers specifically researching the accelerator phenomenon.

1. **Research question study 1:** ***How do accelerators operate as a new generation incubation model?***

Over the last decade, accelerator programs have continued to spread globally as a popular form of support for early-stage ventures. Funded by a mix of investors, public bodies or large corporates, these programs typically provide space, money, mentoring and guidance to batches of entrepreneurs to help them rapidly grow and scale their business idea. However, despite their growing popularity, there is little known documented literature on the different models and methods that have emerged as the field continued to adapt and grow. While most accelerators draw on the pioneering models of Y Combinator and Techstars to some extent, we are increasingly seeing variety in the way new accelerators structure and fund their programs of support. This research sets out to explore how different accelerators operate, how they differentiate themselves from each other and why. The aim of this work is to build on the early body of research on accelerators such as Nesta's Startup Factories (Miller & Bound, 2011), the Seed Accelerators Ranking Project (Hochberg, Cohen & Fedher, 2017), Telefonica's Accelerator and Incubator Ecosystem in Europe (Salido, Sabás & Freixas, 2013) and the

lessons shared by networks such as the Accelerator Assembly[8] and Global Accelerator Network[9], in order to demystify accelerator programs for practitioners, funders and policy makers.

2. **Research question study 2:** ***What has been the role of policy to support accelerators?***

Policymakers are one of the key stakeholders in the entrepreneurial ecosystem in which accelerators are embedded. Here, attention will be paid to the different levels and kind of government involvement in supporting the activities of accelerators. In addition, the dimensions of the kind of policy instruments in use will be covered to understand the policy relevance of startup accelerators. In particular, we aim to discuss whether there are specific policies to create and support accelerators or whether the policies are of a more generic nature and aimed at supporting entrepreneurship in more general terms and take the form of for instance tax relief schemes. Finally, we will look into how the government activates other actors in the accelerator ecosystem such as universities or corporates.

Our analysis is based on a set of 17 interviews with members of accelerator management teams across London, Berlin and Paris complemented with data from secondary sources and interviews with central players of the respective entrepreneurial ecosystems. We identified the policy instruments by screening the web using key words related to acceleration and policy. Additional articles were also selected through manual cross-referencing. In some cases, the business press was a valuable source of information. We subsequently outline policy implications and our recommendations. The implications of local, national and international policy on accelerator activities are discussed.

3. **Research question study 3:** ***How do early-stage ventures effectively learn from the services offered in an accelerator program, and (how) is this relationship affected by venture characteristics?***

Prior research on accelerators as well as popular press tends to empirically examine the impact of acceleration on venture performance and its direct link to certain mechanisms (e.g. Gonzalez-Uribe & Leatherbee, 2017; Hallen et al., 2014). For instance, there is empirical evidence in U.S. that one-third of startups that raised Series A in 2015 went through an accelerator[10]. However, it usually makes the implicit assumption that new ventures accelerate equally and homogeneously (Hughes, Ireland & Morgan, 2007). Yet we know that accelerators

[8] http://www.acceleratorassembly.eu (last consulted on 01/12/2017).
[9] https://www.gan.co (last consulted on 01/12/2017).
[10] Article: https://pitchbook.com/news/articles/one-third-of-us-startups-that-raised-a-series-a-in-2015-went-through-an-accelerator (last consulted on 01/12/2017).

start to develop heterogeneous venture portfolios. And as startup acceleration for different ventures is unlikely to take place in a similar fashion (cf. Hochberg 2016, Pauwels et al., 2016), one may wonder how the logic of accelerators, arguably designed for software and mobile startups, apply to a heterogeneous set of ventures.

Even though the details across accelerator programs can vary, any changes in venture outcomes are tendentiously explained by prior work as evidence of learning within the program (Hallen et al., 2014; Wise & Valliere, 2014). The key assumption underlying this argument is that participating ventures presumably learn from iterative experimentation and the accelerator's input which in turn stimulates venture development. However, there is a lack of evidence that explains this. We investigate this largely unexplored question by looking at the relationship between acceleration, an experimental learning approach and venture performance.

We explored our research question based on qualitative interviews with admitted ventures—our unit of analysis—and the accelerator team of CKIC accelerator. More specifically, we investigated accelerators support venture development such as increasing the investment chances for admitted ventures by looking at how ventures, steered by the accelerator, interacted with their environment and made changes to their business case.

RESEARCH DESIGN

I argue that these particular research questions are best answered with a qualitative research design. At first sight, accelerators seem to be an excellent data provider since it has access to a pool of early-stage ventures, not typically available for study through commonly available databases. As programs are typically run twice a year wi th cohorts, a great volume of data is created. Admitted ventures also tend to experience a similar treatment which aides researchers in making comparisons across a variety of firms. Nevertheless, researchers who seek to evaluate the impact of accelerators face several difficulties.

First, there is little formal academic literature on the subject nor a universally accepted definition of what an accelerator is (Hochberg, 2016; Richter et al., 2018). As new operating models continuously emerge, the lines are blurring regarding the differences between incubators and accelerators which makes the classification of any given organization exceedingly messy. Furthermore, there is significant heterogeneity among accelerators that meet the formal definition.

Second, scholars are faced with the challenge of establishing a causal link between an accelerator intervention and changes in the development trajectory of a venture. A common

concern is the potential occurrence of selection bias which means that the startups are likely to differ in measured or unmeasured baseline characteristics because of the way they were selected. This can bias the generalizability of findings and may lead to an over- or underestimation of a program's effectiveness. One way of overcoming this condition is to match admitted ventures with those that are similar in organizational characteristics but do not participate in accelerators (e.g. Hallen et al., 2014). For instance, a quasi-experimental design can, to some extent, estimate the causal effect of an intervention by retrospectively comparing the observed venture outcomes of both accepted and rejected ventures. However, this is difficult as any information on rejected applicants tends to be of poor quality. In fact, there is a general absence of large-scale representative data sets covering accelerator programs as these entities are small organizations with limited staff and lacking a structured venture tracking process. Recent data collection efforts such as the Entrepreneurship Database Program at Emory University[11] or the MIT Seed Accelerators Ranking Project aim to overcome this data challenge by providing transparency and stimulating discussion among accelerator managers, researchers, investors, policy makers, and other stakeholders in the entrepreneurial ecosystem. There are also other data tools such as Seed-DB[12] which provides accelerator's demographic and portfolio information by scraping data from Crunchbase. However, this information is based on crowdsourced or user-submitted data on startups and while transparent in its data collection, there is a lot of missing data which can increase statistical biases (Porat, 2014).

Third, when comparing the effectiveness of different programs, additional challenges emerge. One difficulty concerns the fact that the goals of programs might vary and another is the ongoing discussion about which measures are best suited to measure the performance of incubation models (e.g. Eveleens et al., 2017). One may find it useful to compare sets of cohorts over time within one program, however, the overall design of the model can change significantly over time. For instance, the very first accelerator founded in Paris spent considerable time searching for an optimal model. It was established originally in 2011 as Le Camping, a publicly-backed entity, with a focus on employment creation and providing little financial support and not taking an equity stake in the ventures in the program. Subsequently, it changed into a private accelerator fund, renamed Numa, replicating its model internationally through joint ventures with local partners such as in Casablanca, Bangalore, and Moscow (see Study 2).

[11] https://www.entrepreneurdata.com (last consulted on 01/12/2017).
[12] http://www.seed-db.com/accelerators (last consulted on 01/12/2017).

Taking into account the aforementioned difficulties regarding empirical work, we adopt a qualitative approach in this thesis using interpretive and case study research methods (such as in-depth interviews) to consider the innate qualities of the phenomena and explore the underlying mechanisms linked to acceleration to explain the relationship between antecedent and outcome variables (Eisenhardt, Graebner & Sonenshein, 2016). This is appropriate for several reasons: (1) there is insufficient extant theory to establish testable hypotheses (Eisenhardt, 1989) and (2) accelerators are a new organizational form with insufficient archival data (Yin, 2009).

THESIS STRUCTURE

The overarching research topic of this dissertation is about what accelerators do and how they impact the entrepreneurial trajectory of ventures. This research responds to calls for more studies exploring the interactions between different levels of analysis such as the technology venture and the accelerator as a support organization.

It consists of three qualitative studies. Although each of them explores separate research questions with a particular focus, they collectively form a coherent set of works examining the impact of a relatively recent type of startup support program (accelerators) on the performance of entrepreneurial ventures and its role in the startup ecosystem. Additionally, an introductory chapter, and a concluding chapter which covers contributions, managerial implications, limitations which provide future research opportunities, have been included.

The first study explores how accelerators shape their model and operate in order to understand what they actually do. We used insights from the literature on business model design (Amit & Zott, 2001) to disentangle the 'business model' used by the accelerator to deliver business support services. The second study looks at the different levels and kind of government involvement in supporting the activities of accelerators as policymakers are one of the key stakeholders in the entrepreneurial ecosystem in which accelerators are embedded. The implications of a local, national and international policy level on accelerator activities are discussed. The third study zooms in on the learning trajectories of ventures within an accelerator and explores the relationship between acceleration, the accelerator's experimental learning approach and the accelerator outcomes across three indicators of venture performance.

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DISCUSSION OF JOINT RESULTS

The main objective of this dissertation is to explore the role that startup support programs, in particular startup accelerators, play in shaping the development of early-stage technology ventures. To do so, I started in the first study by looking at the broader question of what accelerators do and how the configuration of an accelerator is organized in regards to its strategic objectives. In the second study, I investigated the challenges accelerators face in the entrepreneurial ecosystem by reviewing the set of policy support mechanisms for accelerators across international, national and regional levels. In the third study, finally, I explored the variance in acceleration outcomes and how this is related to the learning—a core activity in such a program—of early-stage technology ventures in an accelerator program. In this final chapter, the main findings answering the research question are discussed first. This is followed up with how the findings contribute to the literature on incubation, learning, and experimentation. Furthermore, I discuss a series of recommendations to policy makers, entrepreneurs, and practitioners in the accelerator scene. Finally, a critical reflection on the limitations of this dissertation is given and, based on this, suggestions for further research.

RESEARCH FINDINGS

The overarching research topic of this dissertation is about *what accelerators do and how they impact the entrepreneurial trajectory of ventures*. Table 1 summarizes the research results from the studies.

The first study builds further upon Miller and Bound's (2011) work about accelerators and their implications for the entrepreneurial ecosystem. Their study provided a wealth of insights however, many questions remain outstanding due to the paucity of data. For instance, while most accelerators draw on the pioneering models of Y Combinator and Techstars to some extent, we are increasingly seeing variety in the way new accelerators structure and fund their programs of support. We, therefore, followed the call for more in-depth research on the origins and features of accelerator models and the heterogeneity of their strategies and operations. Against a background of sparse research prior to this, our inductive multiple case study of 13 accelerators in Europe has produced several interesting results that have novel implications for the incubator and entrepreneurship literature and practice.

First, from our data emerged a comprehensive set of diverse features or design elements – program package, strategic focus, selection process, funding structure and alumni relations – to describe the architectural blueprint of an accelerator.

Second, these five design elements allowed us to identify parallels and dissimilarities between different types of accelerators. We conclude that the design of accelerator models is often strongly influenced by the strategic objectives of the key shareholder(s). Accelerators can fit into at least three different configurations that integrate different ways of structuring and running the programs. For instance, the Ecosystem Builder (e.g. Microsoft Ventures Accelerator) tend to be backed or sponsored by large corporates and has a strong focus on (corporate) customers by helping new ventures through the complex corporate decision-making structures. Deal-flow Makers (e.g. Startupbootcamp) are perceived as high-risk investment funds getting early-stage ventures ready for their follow-up investments. Finally, the Welfare Stimulators (e.g. Climate-KIC) are tools typically supported by public institutions with the aim to foster their (entrepreneurial) ecosystems. Each of the different configurations has its own actionable principles, depending heavily on the affiliated strategic partners (investors, corporates, government agencies, etc.). Thus, the model of the accelerator and its services is often dictated by or related to, the capital structure i.e. the type of funding it receives. As each stakeholder strives to invest in something they believe in to generate the right output, we also remain cautious of whether hybrid archetypes have the ability to meet the different expectations of their stakeholders. To conclude, we outlined how accelerators operate as a new generation of incubation model and how they differ from existing incubation models.

As each government wants to develop a balanced ecosystem in which all actors are lined up to promote and sustain pioneering innovations, **the second study** analyzed the evolution of the landscape of policy support for accelerators across international, national and regional/local levels. Considering there is a diversity of accelerator archetypes, we aimed to understand how the development of entrepreneurial ecosystems is promoted by policy makers focusing on the (in-)direct sponsoring of accelerator initiatives and their activities. Our insights are based on a range of 17 interviews with members of accelerator management teams across London, Berlin and Paris complemented with data from secondary sources and interviews with central players of the respective entrepreneurial ecosystems.

First, we extend the potential role of institutional intermediaries, like development organizations, in ecosystems. Besides their core activity to spur entrepreneurial activities and bridge the gaps in capital markets, our results indicate that to create a ‘connected’ ecosystem, institutional intermediaries are useful to policy makers—with the goal to build supportive

commercial infrastructures—by interconnecting and facilitating cooperative and competitive challenges amongst ecosystem actors such as accelerators, incubators, crowdfunding platforms and early-stage investors. Such intermediaries also tend to be well-positioned to shape the ecosystem through the preservation of the aligned interests between policy makers and practitioners.

Second, our study emphasizes that accelerators financed by policy makers cannot be sustainable in the short or even medium term. The ventures they invest in, the programs they have to develop in order to be successful in their objectives and their strategic focus on the local environment do not allow this. Policy makers need to adjust their expectations and take a long-term budget view of this form of support. In addition, policies that promote innovation and entrepreneurship are developed in an ad-hoc and experimental manner and often it is unclear what outcome variables should be measured. The key challenge is to develop appropriate evaluation measures to monitor the effectiveness of accelerators while taking into account the different objectives of accelerators rather than work with "vanity metrics" such as the amount of funding raised by startups.

The third study tackles the main question most practitioners and scholars pose i.e. do accelerators improve startups' survival rates and how? The research that does exist, shows that the impact of accelerators varies widely and suggests that this is linked to the differences in e.g. program design, types of founders admitted, amount of seed money provided and level of equity required to join. This paper explores how the learning path of ventures that perform differently unfold in an accelerator, while taking into account the nature of the ventures. Through an abductive multiple case study of eight accelerated ventures, we generate four explanatory propositions:

> Proposition 1: *Participation in an accelerator program leads to higher execution flexibility, so as to accelerate the development of a viable product-market fit.*
>
> Proposition 2a: *Participation in an accelerator program leads to higher selection flexibility, so as to accelerate the development of a product-market portfolio.*
>
> Proposition 2b: *The effect of participation in an accelerator program on selection flexibility is lower if the venture has high prior market knowledge.*
>
> Proposition 2c: *The effect of participation in an accelerator program on selection flexibility is lower if the venture uses a technology of high maturity.*

By investigating the relationship between the learning path of ventures and the intervention of an accelerator program, this study and its explanatory propositions portray a more nuanced view of how learning occurs in an accelerator and links to outcomes such as a

venture's investor readiness upon graduation. In particular, this study finds not only that an accelerator intervention shapes the learning path of ventures by stimulating them to engage in an experimental learning approach. While all our ventures receive the same accelerator treatment, we identify the emergence of two increasingly divergent learning paths over time, culminating in different venture outcomes upon exit of the accelerator program. More specifically, the distinctiveness can be find in the actions taken related to the selection and execution of opportunities and the associated trade-off between focus and flexibility.

The findings also highlight how venture differently handle this trade-off between the commitment to a certain strategic direction (e.g. pursuing a specific product-market combination) and the flexibility to recognize new opportunities. By showing that the learning paths of a set of ventures are differently impacted by the accelerator program, more customized models are recommended to meet the specific needs of each venture instead of mimicking the standard set by Y Combinator and Techstars, perceiving the accelerator as a 'high throughput' tool.

IMPLICATIONS FOR MANAGEMENT SCIENCE

This thesis contributes in several ways to the current debate about the impact of accelerators on tenant firms. We contribute to the topic of technology entrepreneurship by continuing academic research on the purpose and effectiveness of accelerators in entrepreneurial ecosystems, explaining what they do and how they impact early-stage technology ventures. Drawing upon the findings of three empirical, qualitative studies, this dissertation contributes to three literature streams: incubation, learning, and experimentation.

Incubation literature

All three studies make some unique contributions to this literature stream (Barbero et al., 2014; Bruneel et al., 2012; Rothaermel & Thursby, 2005a, 2005b; Smilor, 1987). First, by adopting a dynamic view on incubation research and accounting for the heterogeneity in incubation models, we have delineated the accelerator model as a new generation of incubation model. To do this, an activity system perspective or design lens has been introduced to identify the key building blocks of an accelerator. This addresses the call for a more theoretically-grounded approach to study incubation models and their evolution in a consistent manner (e.g. Hackett & Dilts, 2004). The design lens also allows us to account for hybrid models and highlight that the variety of incubation models is not only driven by the evolution of tenant firm's requirements and needs but also by the objectives of the shareholders.

Second, by reviewing policy measures on (inter-) national and regional levels, we provide a more nuanced view on the policy relevance of accelerators and its role in an entrepreneurial ecosystem. Additionally, even though accelerators serve as intermediaries within their local ecosystems to offer support for entrepreneurs (Clayton et al., 2018), we also explored how accelerators in their turn benefit from institutional intermediaries. Overall, we contribute by showing that accelerators represent developments that serve to broaden the funding and support landscape rather than simply being a new step in the traditional linear funding and support escalator.

Third, we respond to the call in incubation research, specifically on accelerators, to unpack how certain learning practices drive acceleration outcomes (e.g. Hochberg, 2016; Hallen et al., 2014). Our contribution is the broadening of insights into the question why some ventures experience different outcomes e.g. investor readiness and how learning occurs in an accelerator. It seems that an accelerator program shapes the approach of admitted ventures to commercialization processes and that this effect is related to venture characteristics and acceleration outcomes. In addition, we noticed different intensities of acceleration and the different ways ventures benefit from an incubation model, in this case an accelerator. This is in contrast to prior work on incubation which implicitly assumes that tenant firms are incubated homogeneously and equally.

Learning and Experimentation

The main body of research on incubation claims that incubation models create an environment that is conducive to learning (Eveleens et al., 2017; Bøllingtoft & Ulhøi, 2005) and that it accelerates a venture's learning process (e.g. Bruneel et al., 2012). However, it does not address *how* exactly learning is stimulated in the context of a new generation incubation model of which the most distinguished feature is its focus on learning and their acclaimed way of speeding it up. As learning is an inherent role of experimentation (Murray & Tripsas, 2004; Andries et al., 2013; Bojovic, Genet & Sabatier, 2017), this study adds to prior learning research that favors experimentation by questioning the consequences of the lean startup method and putting it in the context of startup acceleration. Building on the insights of other concepts such as discovery-driven planning (McGrath & Macmillan, 1995) and purposeful experimentation (Murray & Tripsas, 2004), we integrate our understanding of experimentation processes with the literature on incubation and learning and in doing so establish two elements of our understanding of experimentation.

Table 1. Overview research questions, empirical base used to research each question, and the research results.

Study	Research question	Data & Method	Results & Implications
#1	*How do accelerators operate as a new generation incubation model?*	Inductive multiple case study of 13 accelerators	▪ Accelerators distinguished as a new generation of incubation model ▪ Identification of five design elements and three design themes which characterizes the accelerator model ▪ The accelerator design theme is related to the primary objective of the affiliated shareholder supporting or financing the accelerator
#2	*What has been the role of policy to support accelerators?*	Review of policy mechanisms based on interviews, and secondary data	▪ Evidence for the role of institutional intermediaries beyond their core activity to bridge institutional voids. They are useful to build supportive commercial infrastructures by interconnecting and facilitating cooperative and competitive challenges amongst ecosystem actors ▪ Emphasis on the need to develop evaluation measures to monitor the effectiveness of accelerators that take into account the different objectives of accelerators rather than work with "vanity metrics" ▪ Policy makers need to take a more systematic approach for startups to thrive
#3	*How do early-stage ventures effectively learn from the services offered in an accelerator program, and (how) is this relationship affected by venture characteristics?*	Abductive multiple case study of eight ventures undergoing the same accelerator treatment	▪ An accelerator imposes a (lean) experimental learning approach on admitted ventures ▪ Emergence of two divergent learning paths which is related to the venture characteristics i.e. prior market knowledge and level of technology maturity ▪ Revision needed of the "one size fits all" approach assuming acceleration is a way to launch new ventures on rapid learning trajectories in a controlled manner

First, we establish that instead of relying on trial-and-error and bricolage processes during experimentation (Nicholls-Nixon, Cooper & Woo, 2000; Baker & Nelson, 2005), the lean startup (Ries, 2011) – a scientific approach to experimentation – is a key element of the venture's learning strategy in an accelerator. This type of business experimentation is based on the testing of assumptions about the context in which the venture operates, much like scientists test hypotheses (Camuffo, Cordova & Gambardella, 2017).

Second, we expected that the lean startup approach would narrow the set of choices available to the venture i.e. that by learning from the environment and hereby reducing uncertainty, alternative options would be reduced and the current product-market combination would incrementally improve. In contrast, we found that by probing the market, actually can create new options depending on the characteristics of the ventures.

Thus, we suggest that the use of the lean startup approach can be a double-edged sword in heterogeneous venture portfolios of accelerators. For instance, Maine and colleagues (2012) showed that early-stage ventures, especially science-based ventures, benefit from experimentation in various markets simultaneously as a means of spreading market risk. This corroborates with a powerful stream of business model research which advocates experimentation with multiple product-market combinations simultaneously rather than sequentially because it is perceived as a mechanism for hedging risks and opportunities both for early-stage and large firms (Markides, 2013; Casadesus-Masanell & Tarzijan, 2012; Andries et al., 2013).

In fact, the applicability of lean principles—favoring iterative experimentation in a sequential manner—seems to increase the commitment to a course of action hereby limiting their chances to select better alternative product-market combinations. Subsequently, this could negatively impact specific acceleration outcomes such as a venture's investor readiness upon graduation, especially for those that are deeply immersed in science and face considerable technology-market ambiguity.

IMPLICATIONS FOR MANAGEMENT PRACTICE

This dissertation has some useful practical implications for accelerator management teams, prospective program developers as well as entrepreneurs and policy makers. It is hoped that these studies will help them to navigate the accelerator landscape and to find sustainable models to support different types of startups.

Implications for accelerator managers and policy makers

A recurrent question from practitioners and policy makers is how do you configure a program to accelerate (the learning of) ventures instead of increasing the number of surviving startups in a 'safe haven' as in the case of traditional incubation (Cohen & Hochberg, 2014)? In Appendix, you can find a stockpile of good practices from which business accelerator stakeholders can draw on.

Understanding the organizational designs (see Study 1) provide accelerators with useful strategic indications of how and where to position themselves. It also helps policy makers to evaluate the role of these accelerators. Rather than evaluating the effectiveness of all accelerators on the same (vanity) metrics, there is a need to develop measures that take into account the different foci and objectives of different types of accelerators. The framework outlining the three possible configurations of accelerators can also be used by advisors and mentors of early-stage ventures to steer these entrepreneurs towards particular types of accelerators that may best meet their needs. In addition, even though an accelerator main objective is to increase the investment chances of startups, many accelerated startups may still not be commercially viable by the end of the accelerator program. This implies that there may need to be policy development that either provides explicitly for continued active support within the accelerator and/or provides a connected ecosystem that offers support for bridging these capital voids (see Study 2).

Implications for entrepreneurs

Entrepreneurs thinking of applying for an accelerator program should consider that:

(1) Considering accelerators are a fairly new organizational form, it also has to cope with many of the same considerations and challenges as typical startups. For instance, they focus on the earliest and riskiest stages of venture formation and to become financially sustainable is no easy task. Most accelerators are thus still searching for an optimal model and follow a trial-and-error approach which can lead to changes in the overall program design over time (see example of Le Camping in Study 2). Entrepreneurs should preferably talk with alumni in order to have a sense of the accelerator' service portfolio and analyze any changes in the value proposition of the accelerator over time.

(2) Traditional accelerators are originally set up to support software and mobile startups. In case entrepreneurs want to commercialize applied and fundamental scientific research and consider an accelerator to ask for help, caution must be taken in those programs that mimic the standard set by Y Combinator and Techstars. Science-based ventures face greater constraints compared to the software and mobile startups. Consequently, an accelerator

program has to integrate certain features in the program design in order to tackle this such as longer acceleration timeframes, specialized support like high-tech prototyping facilities and sector experts. As the founder of SynbiCITE, a London-based synthetic biology accelerator, noted, "*the acceleration needs to improve the technology readiness level and the investment readiness level by de-risking the commercial opportunity and the technology*". Finally, the program should also enable the science-based venture to explore alternatives and search for (related) applications beyond their initial choice. Because a traditional accelerator—using a very short time frame—will most likely narrow the venture scope which might have an adverse effect. To illustrate, one of the largest and most prolific accelerator investor in the world, SOSV[13], experiments with two deep science accelerators to turn 'scientists into entrepreneurs'. In terms of service offering, they provide fully-equipped wet labs and an immense network of partners to help startups concurrently learn about the technology and the market.

Lastly, one of the acclaimed roles of accelerators is helping startups with timely pivoting by imposing the lean startup method (e.g. Ester, 2017). However, one should take into consideration the consequences of the famed lean startup method before deciding on the integration of such a method to speed up (the learning and) development of ventures (see Study 3). Although this 'scientific experimental' approach mitigates cognitive biases, lean thinking debatably spurs shifts to organizational activities with a focus on incremental improvement and dampening more exploratory search. Thus, policy makers, accelerator management, and entrepreneurs should be aware that the lean startup method is a best practice – mostly in *digital* acceleration models – to attend and deal with the strategic challenges faced by startups such as scarce resources and demand uncertainty.

LIMITATIONS AND AVENUES FOR FURTHER RESEARCH

There are a number of limitations of this qualitative research which warrants future research, both theoretical and empirical. To begin, it considers accelerators primarily located in three of the largest startup ecosystems (London, Berlin, and Paris) and as a consequence, these results may not be generalizable beyond leading accelerator regions. As spatial context may have an important influence on entrepreneurial and innovation ecosystems (Levie, Autio, Acs & Hart, 2014), further research is needed both to compare similar regions in other countries and also to compare our findings with different environments, for example regions outside major

[13] https://sosv.com (last consulted on 16/11/2017)

metropolises and in developing countries (e.g. Roberts & Kempner, 2017). Another interesting avenue for further research is to examine the challenges faced by particular accelerators as they attempt to evolve over time into different models. Nonetheless, within leading startup ecosystems my results are salient, and considering the continuous spread in the use of accelerator programs, it is feasible that generalizability may increase.

In contrast to prior work on incubation which implicitly assumes that ventures are incubated homogeneously and equally, we noticed different intensities of acceleration and the different ways ventures benefit from an accelerator. Drawing on human capital theory (cf. Dimov & Shepherd, 2005), one can plausibly theorize that variations across entrepreneurs can influence accelerator effectiveness. Theoretically, this implies that when designing future impact studies on accelerators, one should take into account "what is important to the accelerators, their startups and subsequent investors" (Dempwolf, 2014:31) and the venture characteristics.

Empirically, further research into the processes of acceleration holds promise. By using abduction in our research (see Study 3) to diagnose the phenomenon of acceleration and accelerated learning, I have generated explanatory propositions which provide assumptions to be challenged in future quantitative work. A possible fruitful approach is to design randomized controlled trials that examine what accelerators do well and what they don't do well. By randomly selecting who receives treatment from a pool of venture applicants, the control and treatment groups can be assembled such that differences in their outcomes are attributable to the program (see Edovald & Firpo, 2016). The issue of small treatment and control groups can also be circumvented by pooling data on startups across multiple accelerators or combining multiple cohorts. Alternatively, if randomization is impractical, a quasi-experimental design that builds a control group out of those that just missed the cut for the program is the next best option.

The adoption of other theory approaches to understand accelerators also holds promise for future research. Indeed, as accelerators, specifically those that provide seed investment, are an organizational innovation that can be perceived as alternative financing vehicles in the equity funding landscape (Drover et al., 2017), an analysis of accelerators using arguments from venture financing research may be fruitful. Accelerators also offer an accessible, natural lab setting to study matters such as entrepreneurial learning and the link between different experimental approaches and venture performance as data collection on dynamic relationships between learning, environment, and entrepreneurial action often proves difficult. Overall, we

hope that the findings of this study will open the way for further systematic analyses of the processes and impacts of accelerator programs.

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APPENDIX – DESIGN OF AN EFFECTIVE ACCELERATION PROCESS

"An accelerator is a toolkit of parts" described Hugh Mason, co-founder of the Joyful Frog Digital Incubator (South East Asia's first startup accelerator). The parts of an acceleration program are typically structured in a linear process: it starts with the sourcing and recruiting of startups followed up with the offering of an intensive temporary program which culminates in a graduation event. In an attempt to develop a sustainable model, each accelerator also has a specific funding structure.

Based on interviews with managers of accelerators and working with them, this research suggests a set of good practices linked to the 'parts' of an acceleration program (see Figure 2). This can drive the effectiveness of such programs in the context of a particular entrepreneurial ecosystem.

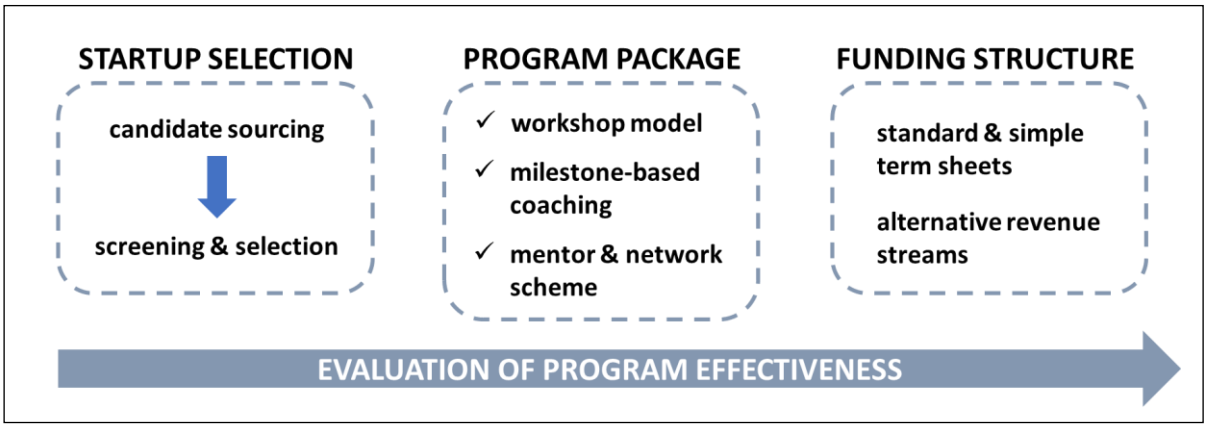

Figure 2. An acceleration program consists of various design parts: [1] startup selection; [2] program package; and [3] funding structure. Each of these design parts are linked to a set of good practices. To improve efficiency and get higher organizational performance, it is also crucial to evaluate a program's effectiveness.

Startup selection – how to filter good bets from bad bets?

Selection procedures tend to be highly structured and routinized to identify the most innovative and high-potential startups. It is a process split in stages. Not only is it extremely challenging to assess startup potential with limited information, one must also first find ways to encourage startups to apply and increase a program's visibility.

Accelerators typically launch an open call for a set application period instead of taking in startups on a rolling basis. When launching an open call for a set application period, one could leverage various social media channels and popular startup platforms (e.g. TechCrunch, F6S, YouNoodle, Gust, and VatorX) to increase a program's visibility. These platforms are for some accelerators the number one source of deal flow and useful as a digital tool to streamline

the review process. Startups wanting to apply, can register on these website platforms by providing basic information about their profile and details about their business concept.

Actively sourcing high-potential startups

What sets better performing accelerators apart from others is the fact that they actively search for and approach best-fitting candidates to avoid a pool of average applicants. Besides receiving referrals of mentors, investors and even other accelerators, a common practice is to organize road shows to showcase successful alumni or sponsoring business plan competitions. Road shows rely on the principle that alumni are your evangelists. It is therefore also useful to publish a list of alumni so startups can do their due diligence by reaching out to them.

During competitions, it is also possible to hand out wild cards in the form of a prize to the best performing businesses at startup competitions. "*Startups can get access to the accelerator by winning pitch competitions, hackathons and ideation bootcamps we sponsor such as the Open Innovation Slam*", said Andrew Burford, the accelerator coach of Climate-KIC UK. The selection team of the accelerator gains the insights of how coachable a startup team can be through these types of activities and this is invaluable for making high quality selection decisions.

Step-wise screening and selecting high-potential startups

"*If I learned something in my time as an investor, it is a shitty business to select startups. It is so tough, it is so hard*", admitted Oussama Amar, partner of TheFamily (an accelerator-like initiative) about how to pick the good ones from the applicant pool. Once the set application period is at its end, one must first filter all submissions to remove the 'junk' before assigning them to a set of judges for review. This can be done manually based on an initial profile screening or automatically by integrating a formalized scoring system to sort out those applications with incomplete information or startups that do not fit with the accelerator.

After filtering, the screening of candidates is organized over different rounds to sharpen the process. Applications are typically screened and shortlisted based on the average score given by a set of judges. Judges tend to be members of the accelerator management team, strategic partners and externals such as entrepreneurs, industry experts, mentors, and investors.

The first round is to reject those that have fatal flaws and perceived disadvantages. Therefore, it is beneficial to align a judge's expertise and a startup's characteristics. Otherwise, one exposes the screening stage to superficial selection decisions considering the limited information in an application form and the short time span for assessing applications. This means that most accelerators also manually assign applications to judges. The managing

director of Healthbox in United Kingdom Yashu Reddy emphasized that all applications are only send to "*mentors with relevant expertise, who would be able to quickly say 'yes, you should consider that company or no you should not'. This makes it a manual application process for us*". The added value of involving mentors in your selection process is to identify a priori whether there is a good fit between the expertise of the mentors and the needs of the applicants.

Furthermore, when crafting a selection process for your accelerator, judges should be informed about the expectations of your program e.g. do you want to pick out the winners or do you want to build them? Sometimes, the submitted idea is superb but the startup team requires strengthening and, in this case, designing a process to encourage the team to fix its flaws and re-apply with a stronger case can sometimes be very beneficial.

Once shortlisted, those startups that passed the first screening are invited for a pitch interview in front of a selection committee. For this second round, some accelerators even organize a bootcamp during which startups get to meet mentors and pitch such as in the case of Startupbootcamp Berlin, as explained by Alex Farcet, founder of Startupbootcamp:

> We bring the best 20 teams to a mini-bootcamp, a month before the program, called 'selection days'. It is a kind of X-factor: you are in, you are out, you are with the best 10. This way we learn how they interact with people, how good they are at pitching and connecting.

Even though relatively brief, these 'face-to-face' interactions are crucial since the aim is not anymore to eliminate weak applicants but to choose those startups that are perceived to be the best fit with the acceleration program. It is also an opportunity to complement the applicant's profile data and get to know the startups' requirements and needs. Some accelerators even cluster their selected startups based on the identified needs. Paul Miller, CEO of the London-based acceleration program Bethnal Green Ventures, informed us how they customize the program based on the needs of the startup:

> We start to treat our startups a bit differently depending on what we think they need. So we have what we call 'proposition seekers'. They kind of have a problem area that they knew about but they haven't quite worked out how to solve it. We have 'customer hunters' who basically have already a value proposition, but they don't know who the customer is yet. Then we have sort of 'scalers' which is basically like those two previous things are sorted and they just need to figure out how to grow.

Although a rigorous multi-stage process has the advantage of reducing the risks to reject high-potential startups, one must consider the total duration of the selection procedure. Typically, the screening and selection runs for around 2-3 months, but time is inversely linked

to the possibility that applicants drop out due to other bids. Thus, understanding the balance between the limited time granted to judges to assess applications and the probability of applicants dropping out, can improve the efficiency of the selection process.

One way of solving this is through the creation of or teaming up with a pre-acceleration program. These part-time programs are designed to act as a discovery tool for the entrepreneur and the accelerator. This way, the startup can explore the potential of its business concept in a sandbox environment without any strings attached while the accelerator can discover the teams with the highest potential in a short-term program. Examples are the once famed Startup Next operated by TechStars and the Greenhouse program offered by the cleantech accelerator Climate-KIC UK.

Program package – how to accelerate startup development?

> It is not only a question of mentoring, it is really a question of building infrastructure, a virtual infrastructure that gives unfair advantages to those admitted in the program which makes their life look like a little more like it is in Silicon Valley,

said also Oussama Amar of TheFamily. Thus, the impact of accelerators on startups goes further than just monetary benefits (if any). One managing director of the famed European accelerator Startupbootcamp even exemplified this by stating the program's investment as a way to "*just help in costs of residing nearby for the duration of the program*" and emphasized that the real added value for startups accelerators is the network and business support . In fact, a "*virtual infrastructure*" referred by Oussama can be created by combining an educational program with coaching, a structured mentoring scheme and privileged access to investor and key customer networks:

Customizing the educational program

In all the acceleration programs we studied, the educational program typically would include a series of educational seminars to e.g. learn and practice lean startup, design thinking and marketing practices. Hereby, some follow highly structured processes with mandatory classes while others are more ad-hoc and lightweight. Although, there is little evidence regarding the effectiveness of each approach, a more customized and assertive approach is favored. Therefore, it helps startup development when expertise resides within an accelerator to both identify the needs of the startups and stimulate entrepreneurs to make use of the provided resources. That is why admitted startups are typically obliged to relocate their business activities to the accelerator premises.

The logic behind the relocation requirement is also based on the extreme time pressures, the heavy execution support, and the demanding schedules required by the accelerator management team. Nevertheless, other accelerators such as the Inception program set up by NVidia Corporation or EU-XCEL program backed by European Commission offer cost-efficient virtual programs with the aim to reach teams across the globe and support far-flung startups with advice and feedback. Depending on the purpose of the accelerator, one has to trade-off the advantages of a virtual scalable program versus the disadvantages of virtual communication.

Structuring accountability through milestone-based coaching

Learning is a key priority in the acceleration process. Andrew Burford emphasizes that the intended (learning) outcome of Climate-KIC UK is to end up with "*teams with a clear focus on the specific markets and value propositions that will enable them to raise meaningful external investment*". To get to this point, the CKIC program as well as others like the South-American accelerator Startup Chile integrated an accountability structure linked to regular counseling with the management team. This setup commits entrepreneurs towards the achievement of milestones which can reduce the time to market and results in better startup outcomes. Additionally, one can integrate a financial incentive or tranched investment scheme in parallel to the achievement of milestones such as validating the product market fit or raising external investment. This 'carrot and stick' approach creates a balance between giving a venture enough autonomy to thrive while maintaining links with achievements during the program. One anonymous startup from Climate-KIC UK reflected upon this:

> The fact you must jump over hurdles, is a good thing. In our case, in order to pass through the stages you are expected to talk with customers and see what they think. So, that you have face-to-face meetings with the real world. It pushes you to get into contact with the real world where you are getting real feedback. And some companies are not going to do it. You know, they are not going to do it, because they get things not going.

At the end of the program, accelerators tend to install a final milestone by organizing a signature event, commonly known as 'Demo Day' or 'Investor Day'. This is an opportunity for participants to pitch upon graduation in front of many prestigious national and foreign investors to raise money. However, the importance (and format) of demo day is an ongoing discussion at accelerators and while still important (e.g. for PR purposes), it may not be the most effective path of follow-on funding. This is echoed in popular press and seconded by the 2017 UK BEIS research paper by pointing out that only 17% of UK-based accelerators are hosting demo days.

The main critique is that investments happen because of relationships and not the pitch itself. It is recommended to move past such events and focus more on building one-on-one relationships between investors and portfolio ventures instead.

Structuring the mentor & network scheme

A central element of such a scheme is to get systematically access to customer, expert and investor networks and hereby enable success or fast failure as it helps streamline startups' search efforts for the ultimate product-market fit. It is all about creating a safe place to explore an idea where somebody can point out possible flaws or problems, in contrast to like going to an investor where you are supposed to have the right answer.

As important as it is for startups to be well-networked, as challenging it is for the accelerator management team to source good mentors that are experts with relevant market experience. It is the 'Achilles-heel' of an accelerator. These experts are essential for helping startups interpret the market information the entrepreneurs have gathered through iterative experimentation. But good mentors are difficult to recruit and even more difficult to retain. And because there are so many interested in being a mentor, it is even more difficult to select. One can address this by carefully interviewing mentors and clearly communicating the goals of the accelerator.

Mentorship is usually voluntary as part of the field's pay-it-forward culture. In return, mentors receive reputational gain and get direct access to other mentors, investors and entrepreneurs. Some are ad hoc mentors, some have a long-term commitment, while others even invest earning them the nickname "*investors in disguise*" according to Samad Masood, former manager of the Fintech Innovation Lab in London. The reasoning is that as a mentor, you can gather fine-grained information about the early-stage ventures which simplifies the due diligence process. Some like Anthony William Catt, former managing director of Oxygen Startup Accelerator in London, believe that "*it can even be an added value as long as there is an accountability mechanism for mentors*".

The connection mentor-startup is facilitated in various ways. Stephan Jaquemot, the managing director of the Berlin-based Microsoft Ventures Accelerator, learned over time that "*the only method that works is: rent a room in a restaurant, bring in food and a lot of alcohol and close the doors, and in 4h magic happens.*"

Other options are to organize a 'mentoring marathon' (e.g. TechStars), to tailor matching or to introduce them on an as-needed basis. Overall, an accelerator should structure the mentoring & networking scheme, enabling startups to focus on core objectives since the

costs and time related to identify mentors and to arrange meetings are reduced. It is also very clear that the rationale of specialized programs is to provide stronger relevant contacts and subsequently offer more useful advice compared to generic programs. This has been seconded by various accelerator managers. To illustrate, the founder of the deep tech accelerator SynbiCITE in London, Stephen Chambers, strongly believed that "*accelerator specialization allows focus and concentration of mentors and experts which are key factors in producing successful outcomes for the participants*".

Thus, accelerators must actively engage with the entrepreneurial community, not only to entice startups to apply, but also to build a connected ecosystem i.e. a rich community of startups, corporates, experts and other startup support entities. For instance, the survival rates of accelerated startups can increase if the program connects to other startup support entities that are congruent with a venture's stage of growth. To illustrate, the Paris-based Accélérateur signed a friendship agreement with London startup support program Level39 to help startups grow internationally, while London-based Bethnal Green Ventures has launched a follow-on fund that is open to not just their alumni but also to alumni of other accelerators. Thus, any accelerator should not only be designed to address critical needs of their admitted startups but also leverage the particular strengths of an ecosystem.

Finally, building a connected ecosystem also attracts professional service firms that can offer exclusive partner deals to the admitted startups e.g. free cloud services by AWS Activate, discounts on project management tools like Podio or Salesforce. These service providers are interested as startups are perceived as potential clients in the future once you helped them throughout their direst times with free goodies and perks.

All in all, by pooling resources from a variety of experts, business and technology providers contributes to the creation of a virtual infrastructure with unfair advantages for admitted startups.

Funding structure – how to design a sustainable model?

"*Why are we doing this?*" commented John Lewis of the Tektos Accelerator, during a panel discussion on sustainable business models. An accelerator aims to position startups for long-term success but to continue its operations, the rationale is clear as John explained:

> It must make money! I mean a lot of people are saying they are doing it for the ecosystem etc. etc. but there must be a reason that you can sustain this. To keep it going, you must make money. In the very beginning when I first did it, the whole idea of the classic accelerator is where you would get funded by investors, corporates or government, you would do a cohort, fund the startups, then you

would do a demo day, people would fund it. Basically, accelerators started to evolve into a sort of micro VC or mini VC. Think about Y Combinator, TechStars, and 500 Startups, they have funds of 100 million of dollars. Are they an accelerator or a VC fund with extremely low-cost deal flow and extremely low-cost of equity when they buy it?

More generally, a critical success factor is to ensure long-term sustainability considering the increasing number of accelerators and the long-term strategy to cash out.

Standardizing and simplifying the term sheets upon investment (if any)

To simplify the investment process, accelerators typically standardize their term sheets as it is hard to negotiate bespoke terms with each startup. Simple and 'founder-friendly' term sheets can avoid legal fees and allows the investment discussion to focus on what truly matters i.e. how to identify the product-market fit. Jens Pippig from ProSiebenSat.1 Accelerator claimed that they "*standardize the investment because we don't have time to negotiate with the teams and we also believe if you start negotiating with teams about their valuation, you create a lot of tension*". Similarly, Alex Farcet from Startupbootcamp only provides a standardized offer "*to try to not get into any negotiation discussions because when you do, you waste a lot of valuable time*".

Therefore, it is useful to include an easy-to-find FAQ component on the program's website, so startups are made aware of the terms before they apply. Some even encourage to make the term sheet completely public, giving founders a detailed look at what they can expect from a seed funding deal with the accelerator. Eventual concerns of those who are selected to participate can then instantly be mediated by connecting alumni of the program with the founders of the newly admitted startup.

Finally, for those programs that do charge a program fee, it is wise to skip the small print and instead put the investment deal post-fee on the front pages since transparency is key to build a trust relationship with admitted startups.

Creating different revenue streams

The rationale of traditional investment models is based on the principle that one can do a lot of little bets and fail cheaply and fast. Traditional investment models provide stipends or seed investment and receive an equity stake in the portfolio venture in return (on average 5 – 10% ordinary shares). The capital provided typically runs from $25,000 to $150,000 and is offered at the very earliest stages. In contrast with a typical spray and pray technique, an accelerator allows to track in real-time and identify the best performing ones. This create options to then double down on investment later in or after the program. However, with an expected cash-out

of around 5 – 7 years and the reliance on developed exit markets, accelerators can only be sustainable with continued financial support for several years. Due to the relatively long-term strategy and the relatively small number of exits, some accelerators are urged to explore new revenue streams to cover the operational costs. A string of alternatives has been identified over time to get some cash in. An overview of revenue-generating options can be found in Table 2. Alternative revenues are sourced from both the participants of the program as well as services offered to actors active in the startup ecosystem.

Table 2. An overview of revenue-generating options in order to complement the working capital from accelerator stakeholders.

PROGRAM-BASED	SERVICE-BASED
▪ management fees linked to investment fund (if any) e.g. Deep Science Ventures UK ▪ program tuition fees e.g. Pi Labs ▪ preferential right agreements to market startups' products/services e.g. Wayra Accelerator ▪ profit sharing - return 5% of future sales revenue ▪ finders' fee by matching appropriate investors with startups (analogous to use of convertible note)	▪ office subletting e.g. Startupbootcamp Rainmaking Loft ▪ event hosting e.g. Numa Paris, TheFamily ▪ CoLab Spaces to connect startups with corporates and consult both parties on development of Proof of Concepts e.g. Startupbootcamp ▪ paid learning programs for externals e.g. Truestart, L'Accelerateur ▪ inclusion of corporate innovation projects e.g. Swiss Startup Factory, Kickstart Accelerator

BEHIND THE SCENES: EVALUATION AND THE RISK OF UNEVEN ACCELERATION

Another key challenge for accelerators is to evaluate a program in a rigorous manner considering the lean management style of the accelerator. In fact, there is a general absence of large-scale representative data sets covering acceleration programs as these entities are small organizations with limited staff and lacking a structured venture tracking process.

As a result, most accelerator management teams typically play dodgeball with vanity metrics when asked to proof any impact. Vanity metrics are top-line performance statistics that look good but are not necessarily causally related to the impact of the accelerator on startup development (e.g. number of applicants, the total follow-on funding). Even Paul Graham of Y Combinator admitted in his blog back in 2012 that the "*one thing you can measure is dangerously misleading. The one thing we can track precisely is how well the startups in each*

batch do at fundraising after Demo Day. But we know that's the wrong metric…"[14]. Andrew Burford comments that at least one should look at "*the median follow-on funding metric rather than the mean. An interstellar performance from one start up can disproportionately skew the follow-on funding as a mean. The median however is a statistic that shows consistency – which I think is a much better measure of the accelerator*".

Besides showing 'direct' impact, it is also no easy job to know which program practices work i.e. to establish a causal link between an accelerator intervention and change in the development trajectory of a startup. Currently, it is common practice to change specific program elements based on intuition and experience.

To avoid that certain half-truths (based on vanity metrics) are created, it is essential to pose two main questions:

- what is the job of the accelerator to be done?
- why is a program practice linked to the improvement of startup performance?

Building up a body of evidence with customized metrics to show impact

The job of the accelerator to be done can be different since not all accelerators have the same goals. While most accelerators draw on the pioneering models of Y-Combinator and TechStars to some extent, we are increasingly seeing variety in the way new accelerators structure and fund their programs of support. We have identified in prior research 3 different types of accelerators based on the strategic objectives of the stakeholders. The different types are conceptualized as Ecosystem Builders, Welfare Stimulators and Deal-flow Makers (see figure 3).

To benchmark acceleration key performance indicators (KPI) from a set of different accelerator types, such as seen in the Seed Accelerator Rankings Project[15], is arguably like comparing apples with oranges. That is, the KPI comparison between an investment-driven Dealflow Maker with a mission-driven Welfare Stimulator is difficult. For instance, Welfare Stimulators are more likely to admit early-stage startups that clearly need the support. This results in a higher failure rate because of the higher risk taken compared to those programs who from an investor perspective typically invest in more established startups.

Therefore, accelerators don't need to benchmark themselves to show that the program is doing what it sets out to do. Instead, it requires customized metrics and performance targets. For instance, Ecosystem Builder accelerators such as the Kickstart Accelerator based in

[14] http://www.paulgraham.com/swan.html
[15] http://seedrankings.com/

Switzerland quantifies its impact by counting the number of successful proof-of-concept trials between startups and corporates. In turn, Welfare Stimulators like Bethnal Green Ventures in London or NUMA Paris measure its impact on the region by tracking the growth of its network. Other programs like the Ignite London acceleration program also request in a structured way for post-program feedback (usually anonymize input to ensure honest answers) e.g. by asking graduated startups to rate their experience of being on the program and whether they would recommend it to another startup.

	DESCRIPTION	EXAMPLES OF METRICS
WELFARE STIMULATORS	Tools typically supported by public institutions with the aim to foster their (entrepreneurial) ecosystems. They are mission-driven and focused on societal value *E.g. Bethnal Green Ventures || Numa Paris*	▪ Survival rate ▪ Ratio of new employees ▪ Diversity in participants ▪ IP rights applications/granted
ECOSYSTEM BUILDERS	Backed or sponsored by large corporates, such models help new ventures through the complex corporate decision-making structures and scale the proof-of-concepts. *E.g. Fintech Innovation Lab || Starburst Accelerator*	▪ # of proof of concept trials started and finalized ▪ # of partnerships with corporate clients ▪ Internal cultural changes through the rise of a corporate's own intrapreneurs
DEALFLOW MAKERS	High-risk investment funds aimed at getting early-stage ventures ready for their follow-up investments. *E.g. TheFamily || Axel Springer Plug & Play*	▪ Time taken after graduating to receive further funding ▪ # of follow-on funding raised ▪ Revenue growth since graduating ▪ # of exits

Figure 3. A description of the 3 different types of accelerators (based on the strategic objectives of the stakeholders) and examples of key performance indicators used by each.

All this builds up a body of evidence that represents a track record which third parties, such as potential funders, can consult before offering their support.

Building up a body of evidence to show what works

Besides measuring impact outcomes to proof that the program has reached its goals (see for an overview Fig. 4), several accelerators running multiple programs like Climate-KIC UK, Startupbootcamp and TechStars continuously attempt to identify those program practices that work. Based on the collective learning of the managing directors, play books are even created as Jon Bradford, former MD of the London-based TechStars program proudly showed:

> *This is a paper version of our bible. In a weeks' time it will be different again because there is a living document on the internet somewhere where we are constantly adding best practices. We will have multiple MD's, all who run their programs autonomously and with*

the ability to share best practices in a way that nobody else does. We do not compete with each other and we push each other to the limit where their best practice sits.

But if taken seriously, a comparative analysis between participants and a valid counterfactual group should be carried out to more comprehensively assess performance. Therefore, the startup development of participants needs to be linked and compared to a control group e.g. those that applied but are not accepted. The latter can be tracked by integrating simple metrics into the application form as well as using online sources. The alternative is to capture periodically (e.g. weekly) the data of the participants to measure their progress.

Considering unequal acceleration

Startup development can be accelerated however there is skepticism that it can be done generically. Accelerators could recruit similar startups, being part of the same industry or a cohort of heterogeneous start-ups, with no common ground. These choices depend on the goals of the accelerator. For instance, Y Combinator admitted in its summer batch 2017 science-based ventures that build an outdoor farming robot, a sonar bracelet for visually impaired individuals and a self-driving personal aircraft . However, one may wonder whether the logic of a standardized accelerator model, arguably designed for Internet-based startups, will fall short for those specific startups? Yashu Reddy from Healthbox UK highlighted that they only focus on "*tech-enabled services and held by IT-companies because they are capital-efficient businesses*". That is because she believes that "*only these startups can test and refine their business model in four months. So, Healthbox typically doesn't invest in pharma or device companies because their life cycles are a bit longer. They are not as capital-efficient!*".

Unlike software and mobile startups of which most innovations are based on established programming languages and architectures, ventures attempting to commercialize scientific advances are typically constrained in their ability to prototype and use of iterative experiments because of their higher development costs coupled with a long cycle time. It is therefore dangerous to assume that acceleration is a way to launch new ventures on rapid learning trajectories in a controlled manner.

Standardized accelerator models risk to accelerate ventures unevenly and even fall short for those ventures that aren't developing typical software and mobile products. For instance, a traditional accelerator using a very short time frame (e.g. 3-4 months), most likely would narrow the venture scope of science-based ventures in their search for applications which might have an adverse effect in the long term. Even though the limited duration of a program allows to be more reactive to new trends such as smart cities and the token economy, one must take

into account any potential detrimental effects upon configuring the selection process and evaluating the program.

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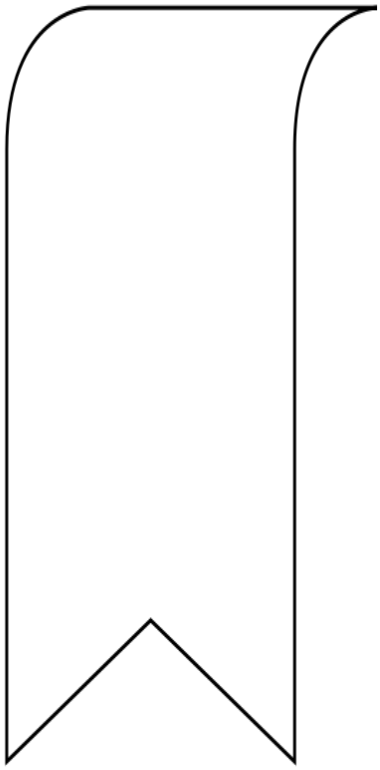

STUDY 1

UNDERSTANDING A NEW GENERATION INCUBATION MODEL: THE ACCELERATOR

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ABSTRACT

Prior research hints at the accelerator as a new generation incubation model. Accelerators have become an umbrella term for any program providing a service structure of mentorship, networking opportunities and access to funding. The challenge, however, is to understand their distinctive characteristics and profiles geared towards reinforcing business startups. How do accelerators operate as a new generation incubation model and how do they differ from existing incubation mechanisms? This inductive study investigates 13 accelerators across Europe and adopts a design lens to identify the accelerator model's key design parameters. We identify five key building blocks and distinguish between three different types of accelerators, taking the primary design theme of the accelerator into account. We contribute to the incubation literature by extending recognition of the heterogeneity of incubation models, by delineating the accelerator as a distinctive incubation model and by introducing the design lens as a useful theoretical framework to investigate incubation models and their evolution.

Key words: Incubation models; accelerators; activity system perspective; design

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INTRODUCTION

Over the past decades a wide variety of incubation mechanisms have been introduced by policy makers, private investors, corporates, universities, research institutes etc. to support and accelerate the creation of successful entrepreneurial companies. Whilst extant literature on incubation mechanisms agrees on their contribution to the nurturing of new ventures in general, it also points to the need to take the heterogeneity of different incubation models into account (Barbero, Casillas, Wright, & Garcia, 2014). Incubation models have evolved (Bruneel, Ratinho, Clarysse, & Groen, 2012) and continue to evolve into new generation incubation models. It is therefore important to gain insights into the specific features of evolving incubation models to assess their working and performance (Mian, 1997) and their impact on incubated ventures (Barbero, Casillas, Ramos, & Guitar, 2012).

A new generation incubation model, introduced in Europe in the last five years, is that of the seed accelerator program. "Accelerators" are organizations that aim to accelerate successful venture creation by providing specific incubation services, focused on education and mentoring, during an intensive program of limited duration (Cohen & Hochberg, 2014; Miller & Bound, 2011). Accelerators emerged mid-2000 as a response to the shortcomings of previous generation incubation models, which are primarily focused on providing office space and in-house business support services (Bruneel et al., 2012). The first accelerator, Y Combinator, was established in 2005 in Cambridge, Massachusetts, and has been a source of inspiration for many accelerators to follow. In 2009, the Difference Engine kick-started the European accelerator sector and in 2013, Seed-DB, a platform which analyses accelerators and their companies worldwide, reported over 213 accelerators worldwide, which have supported approximately 3,800 new ventures.

Yet, despite these success examples and the rapid proliferation of accelerators across different regions, empirical and theoretical knowledge about the distinct characteristics and drivers of this new generation incubation model is scant (Birdsall, Jones, Lee, Somerset, & Takaki, 2013). Furthermore, insights from the extant incubation literature only partly help us to understand the working of accelerators. Research on incubation models has provided in-depth insights into the differences in the organization, activities, services and objectives of incubator types (Aernoudt, 2004). However, we cannot simply assume these differences hold for accelerators, which seem to extend existing approaches to a very distinctive type of incubator. In addition, the business incubation literature lacks a theoretical lens to analyze and explain the heterogeneity among different incubation models, with the majority of published studies being largely descriptive in nature (Bruneel et al., 2012; Hackett & Dilts, 2004).

Against this backdrop, we set out to explore 13 accelerators in Europe in order to answer the following research question: "How do accelerators operate as a new generation incubation model?" Specifically, we introduce the design perspective developed by Zott and Amit (2010) in their study about business models as a useful theoretical lens to look at the phenomenon and identify an accelerator's primary design parameters. This enables understanding of how accelerators differ from previous generation incubation models and how they particularly create value for their ventures. By doing so, we aim to contribute to the existing incubation literature in two ways. First, by delineating accelerators as a new generation incubation model. By identifying accelerators' key design parameters, we conceptualize both the dimensions of their heterogeneity and their distinctiveness in relation to other incubation models. Second, by introducing a design lens as an appropriate theoretical framework for investigating new incubation models, so enabling the consistent monitoring of incubation model evolution.

THEORETICAL BACKGROUND

Incubation models

An incubation model is broadly defined as the way in which an incubation entity provides support to startups to improve the probability of survival of the portfolio companies and accelerate their development. It is the model used by the organization or mechanism to deliver incubation services to startup companies and create and capture value from them (Amit & Zott, 2001; George & Bock, 2011). Incubation models have evolved since the establishment of the first incubators, science parks, innovation centers and the like. Academic research has followed this evolution by providing a variety of studies focusing on different incubation model characteristics, classifications and typologies, and their evolution over time.

Incubation model characteristics, classifications and typologies

The main body of research on incubation has devoted considerable attention to describing different incubation mechanisms and models (Barbero et al., 2014). The literature on academic entrepreneurship for example, focuses on how universities nurture spin-offs into successful startups via internal approaches such as technology transfer offices, science parks and incubation infrastructures (Clarysse, Wright, Lockett, Van de Velde, & Vohora, 2005; Van Looy, Debackere, & Andries, 2003). The literature on corporate entrepreneurship illustrates how large companies, similar to universities, rely on quasi-internal activities and develop in-house incubation facilities to assist new startups as a means to source new ideas (Becker & Gassmann, 2006; Grimaldi & Grandi, 2005; Hill & Birkinshaw, 2014). In the public sector,

business incubators are recognized as a popular instrument to foster entrepreneurship and regional economic development (Smilor & Gill, 1986) and in the private sector incubation through rent-seeking has grown into a separate industry, with the involvement of investors as a way to improve the deal flow of their portfolio (Miller & Bound, 2011). The latter is perceived as a high-risk investment model for the support of high-potential new ventures, originating from the venture capital and corporate industry.

As incubation mechanisms have matured and multiplied, different incubation models have emerged, resulting in a plethora of definitions and typologies, based on a variety of distinguishing characteristics. The most fundamental categorization concerns the distinction between non-profit and for-profit incubation models (Aernoudt, 2004; Grimaldi & Grandi, 2005). Beyond this basic dichotomy, research provided different classifications primarily depending on strategic objectives, service offerings and competitive focus, the latter distinguishing between industry sector, type of startup, phase of intervention and geographical reach (Vanderstraeten & Matthyssens, 2012). Barbero et al. (2014) converge on four broad models: (1) business innovation centers, with a focus on regional economic development, (2) university incubators to facilitate technology commercialization, (3) research incubators embedded in research institutes to valorize research output, and (4) stand-alone incubators, focused on selecting and supporting high-potential ventures.

Previous research also identified a range of basic incubation model components (Bergek & Norrman, 2008; Hackett & Dilts, 2004). Despite the differences and overlaps between incubation models, an incubation model's main components include at least four of the five following services: (1) access to physical resources, (2) office support services, (3) access to capital, (4) process support, and (5) networking services (Carayannis & von Zedtwitz, 2005), with a primary focus on overcoming the participating venture's liability of newness, and hence improve its survival rate (Dettwiler, Lindelof, & Lofsten, 2006; Schwartz, 2013).

Incubation model evolution

A more recent stream of studies adopts a dynamic view on incubation research, by focusing on the evolution of incubation models over time (Grimaldi & Grandi, 2005). These studies advance the existence of a generational sequence of incubation models, led by changing needs of participating ventures. They argue that each generation of incubation models adapts its value proposition to the evolving needs of participating ventures (Bruneel et al., 2012).

The first generation of incubation models, introduced in the early nineties, primarily focused on providing physical and financial resource support (for example office space and

small financial injections) to early-stage high potential ventures (Phan, Siegel, & Wright, 2005). Throughout the nineties, new incubation models emerged, which gradually moved away from a mere focus on offering basic office space and financial support, towards a broad range of more intangible high value added services. This second generation of incubation models included, amongst other things, services such as aid in evaluating different market opportunities, access to knowledge intensive services, product development support, access to knowledge, expertise and networks of entrepreneurs and provision of entrepreneurial finance (Clarysse & Bruneel, 2007; Soetanto & Jack, 2013). More recently, we can identify a further shift, hinting at a new generation of incubation models, which focuses on knowledge intensive business services, moving away almost entirely from the primary services for which the incubation models were founded (i.e. rental services).

The accelerator: a new generation incubation model?

The accelerator model is an exemplar of the recent shift towards a focus on intangible, knowledge intensive, support services in incubation services. An accelerator is an organization, which aims to accelerate new venture creation by providing education and mentoring to cohorts of ventures during a limited time (Cohen & Hochberg, 2014). Although the accelerator model includes intangible services, such as mentoring and networking, it has a number of other specific features that sets it apart from existing incubation models (Isabelle, 2013). First, they are not primarily designed to provide physical resources or office support services over a long period of time. Second, they typically offer pre-seed investment, usually in exchange for equity. Third, they are less focused on venture capitalists as a next step of finance, but are more closely connected to business angels and small-scale individual investors. One of the reasons for this difference is that their focus is on early-stage tech startups for which the costs of experimentation have dropped significantly in the last decade, rather than capital-intensive startups, such as technology-oriented spin-offs from universities. Fourth, the accelerator model places emphasis on business development and aims to develop startups into investment ready businesses by offering intensive mentoring sessions and networking opportunities, alongside a supportive peer-to-peer environment and entrepreneurial culture (Christiansen, 2009). Fifth, the accelerator model concerns time-limited support (on average 3 to 6 months), focused on intense interaction, monitoring and education to enable rapid progress, although some provide continued networking support beyond the program as well.

Although literature suggests that the accelerator model can be considered a new generation incubation model (Wise & Valliere, 2014), formal analysis about its particular

characteristics and drivers is lacking. The few available studies examining accelerators are largely descriptive in nature and lack a consistent theoretical lens to study the phenomenon (Cohen & Hochberg, 2014; Miller & Bound, 2011). We address this gap by providing a more informed image of new generation incubation models in general and the accelerator model in particular, as part of a broader effort to introduce the design lens as a systematic methodological approach to study incubation evolution.

A design lens to study incubation model evolution

The design lens introduced by Zott and Amit in their research about business model design (Amit & Zott, 2012; Zott & Amit, 2007, 2010) is a useful framework to study incubation model evolution. This stream of research introduces the concept of an organization's activity system, concerning the set of interdependent organizational activities conducted by the focal organization and its partners, enabling the organization to create, deliver and capture value in concert with these partners. It suggests two sets of design parameters that should be taken into account when choosing the appropriate "model" or "template" for the activity system to perform its activities: design elements and design themes. Design elements are the key building blocks of the activity system's model, which set it apart from other models. Design themes represent the common theme that orchestrates and connects the different elements into a particular model and as such categorize different models of activity systems (Amit & Zott, 2012).

The activity system design perspective is particularly relevant to study a new generation incubation model, as it provides a conceptual toolbox to identify and assess its key elements and themes. It can be used to, on one hand, distinguish the new model from existing models, through identifying the model's vital elements and, on the other hand, reveal the heterogeneity within the new model, through identifying the main themes characterizing different types within the new generation model. As such it provides a structured framework for incubation researchers to consistently track and assess incubation model evolution.

METHODS

Given the lack of previous research specifically on accelerators, the contemporary and therefore still relatively unexplored subject under study, and our "how"-research question, we choose an inductive, multiple case study design as a research strategy (Eisenhardt & Graebner, 2007; Tracy, 2010).

Sample

We used a theoretical snowball sampling approach (Yin, 2013). This means that we started our sampling by only focusing on cases that comply with a predefined strict definition of an accelerator, clearly delineating the accelerator model from other incubation models. Based on Miller and Bound (2011) we define an accelerator as having the following six characteristics: (1) Possible offer of upfront investment (£10k - £50k), often in exchange for equity (~5-10%); (2) Time-limited support, comprising programmed events and intensive mentoring; (3) An application process that is "in principle" open to all, yet highly competitive; (4) Cohorts or classes of startups rather than individual companies; (5) Mostly a focus on small teams, not individual founders; (6) Periodic graduation with a Demo Day/Investor Day. Using the above criteria, we identified an initial dataset of 41 accelerators in Europe that complied with our strict accelerator definition.

We further imposed two additional criteria on the dataset to result in a final selection of 14 cases (a) the cases are viewed by experts who sit in the European accelerator advisory board, called the Accelerator Assembly, as accelerators which have developed a track record and have signalled to stay in the field for a longer time period and (b) they are located in one of the three "leading accelerator regions" in Europe: London, Paris and Berlin. The Regional Entrepreneurship and Development Index (REDI), a complex composite indicator of regional entrepreneurship that captures both individual-level actions as well as contextual influences such as the financial possibilities of businesses, ranked the regional entrepreneurial performance of London, Ile-de-France and Berlin amongst the top in the European Union (Szerb, Acs, Autio, Ortega-Argilés, & Komlósi, 2014). These three cities created the conditions for accelerators to take off as they have a sufficiently dense population of entrepreneurial ventures to be attractive for accelerators and have a developed seed stage funding supply resulting in better circumstances for startups and startup programs to make an impact (Salido, Sabás, & Freixas, 2013).

We argue that focusing on the best performing accelerators only contributes to our theoretical sampling approach as it facilitates access to rich insights about an accelerator's key design parameters. As the accelerator model is still very young (average age of 3 years) we relied on expert judgements rather than established performance indicators in incubation research such as the number of jobs created, number of graduates and occupancy rate (Barbero et al., 2012). Among the 14 selected, the managing directors of 13 accelerators agreed to participate in our study. Table 1 provides a final list of the 13 accelerators included in the study and their key characteristics.

Please insert Table 1 here

Data collection

We used two data sources: interviews and archival data. The primary data source involved semi-structured interviews with the managing directors of the 13 accelerators selected, during the second half of 2013 and early 2014, using the repertory grid method as a technique to structure the interviews (Easterby-Smith, Thorpe, & Holman, 1996). The repertory grid technique focuses on the construction of meaning by individual participants in a specific setting and was chosen as a technique to supplement standard interview questions, (such as "Can you describe your ideal portfolio company?" "What makes your accelerator unique? etc.), due to its comparative efficiency and flexibility and its greater potential for objective validity and reproducibility (Symon & Cassell, 1998). Interviews ranged from 50 minutes to 1.5 hours and always involved two researchers: one conducting the interview, and the other taking field notes. Each interview was tape-recorded and transcribed, which resulted in 215 pages of total interview transcripts. The French-speaking interviewees were interviewed in their mother tongue, transcribed in French and then translated into English.

The interview data was supplemented with archival data from various sources, including industry reports, internal accelerator program records, company presentations, annual reports, websites and news articles about the organization. These secondary data sources were important sources of information to familiarize with the context and construct preliminary case histories of each accelerator, as well as served as triangulation sources to validate emerging insights from the interviews (Huberman & Miles, 1983).

Data analysis

Our data analysis evolved in three stages. We started with writing individual case histories of each case using all archival data available. We then contacted the managing directors of the accelerators through email to ask for an interview, with the preliminary case history of their accelerator attached, in order to increase response rates (Yin, 2013). Further communication through email and telephone was used to schedule interviews and validate the preliminary case histories.

Once the case histories were validated and interviews were scheduled, we proceeded with conducting the interviews, using the repertory grid method both as a data collection and data analysis technique. We followed the three stages of the basic repertory grid technique

(Easterby-Smith et al., 1996). First, we defined 15 accelerators (the 13 cases under study together with the 2 pioneering accelerators in US: Y Combinator and Techstars US) as our "grid elements" (=objects of attention within the domain of investigation). Each grid element was written down onto an individual card. Second, we used "triads" and "the full context form" (Tan & Hunter, 2002) as two techniques to elicit "constructs" (=qualities describing and differentiating elements).

During the first part of the interview we constructed a triad by combining the interviewee's own accelerator with two accelerators, randomly drawn from the pack of cards. The three cards were presented to the interviewee, who was then asked to identify ways in which two accelerators are similar yet different or opposite from the third. This process was repeated until no new constructs could be identified. In the second part of the interview, we presented the full repertory of cards to the interviewee and requested him or her to sort the stack of cards into any number of discrete piles based on whatever similarity criteria the interviewee chose to apply. After the sorting was completed, the interviewee was asked to provide a descriptive title for each pile of elements. Finally, after completion of each interview, we constructed a "grid" (=matrix) of grid elements and constructs and completed each cell of the grid with information from the interview (i.e. for each accelerator we entered data in the cells representing how the accelerator is regarded in terms of the identified constructs).

The third stage of our data analysis involved a cross-case analysis. As suggested by Eisenhardt (1989), one tactic in cross-case analysis is to select categories and dimensions and then to look for inter-case similarities and differences. The categories and dimensions were suggested by the elements and constructs from the grids built up for each interview and all cases were replicated against one another (Yin, 2013). We counted an initial number of 17 constructs identified by the interviewees and applied two rounds of comparative analysis to cluster constructs "that go together" (Miles & Huberman, 1994).

A first round of analysis resulted in grouping the 17 constructs together in 9 elements. After a second round, we eventually agreed upon a final set of 5 design elements. The final set of 5 design elements were reviewed by the interview respondents to further validate our results. We finalized our analysis by identifying themes cutting across cases. The full context form technique applied during the interviews resulted in a number of different groups of accelerators, ranging from 2 to 5 different groups. We further compared all of the data available for each case in a matrix to reveal element relationships and agreed upon three distinct groups of accelerators in our dataset. The three different groups were again reviewed by the interview respondents to validate our findings. We employed an insider-outsider approach, which means

that a third person was involved in the analysis rounds as an independent researcher so that the credibility of the findings would not rely solely on the interpretations of those conducting the interviews (Gioia, Price, Hamilton, & Thomas, 2010).

FINDINGS

This section reports the results from the repertory grid construction and cross-case analysis. We discuss the five accelerator design *elements* and three accelerator design *themes* that emerged from our findings.

Design elements

The design elements of an activity system capture the key parameters that describe the activity system's architecture (Zott & Amit, 2010). As outlined above, the 5 design elements of the accelerator model were identified through comparative analysis of the 13 cases involved, which led us to cluster the 17 constructs identified by the interview respondents into 5 agreed upon design elements. Figure 1 and Table 2 illustrate how we arrived at the final selection by respectively showing which of the 17 constructs were clustered together in a design element, and portraying supportive quotes for each of the 17 constructs. In what follows we describe each design element in detail.

Please insert Figure 1 here

Please insert Table 2 here

Program package

The program package consists of all services the accelerator offers to its portfolio ventures. The accelerator program package's core services that most differentiate the accelerator from previous generation incubation models are the well-elaborated and carefully planned mentoring services. Mentors are typically experienced entrepreneurs, which are heavily vetted before being included in the accelerator program. They are matched to specific ventures based upon speed dating or match making events and are frequently evaluated by the accelerator management team. Mentors help ventures to define their business model and to connect with customers and investors. Although there are variations in how this mentoring is operationalized, mentoring services are evident across all accelerators.

An accelerator's program package most often also includes a curriculum or training program, covering a variety of topics such as finance, marketing and management, which the new ventures have to go through when entering the accelerator program. The ProSiebenSat.1 accelerator for instance includes courses in finance, user design, PR, marketing and legal aspects, and a program of ad hoc events, such as, expert workshops and inspiring lectures.

In addition to educational services, accelerators offer regular counselling services, provided by the accelerator management team. These are offered in the form of weekly "office hours" or evaluation moments and provide the portfolio companies with business assistance and enable monitoring of their progress.

The portfolio companies are also given the opportunity to come into contact with customers and investors through the organization of demo days or investor days. During these days, customers and/or investors are invited to visit the accelerator and attend portfolio companies' presentations, followed by formal and informal networking opportunities.

Location services are also part of the accelerator program package, but are limited to co-location in a shared open office space, with the aim to encourage collaboration and peer-to-peer learning.

Finally, the program package also consists of investment opportunities offered to the portfolio companies. We find that most programs (8 out of 13) follow the traditional accelerator model of offering a small amount of funding in exchange for equity (ranging from £3,600–£50,000 for 3–10%). The equity stakes are typically made on a dilutable basis with pro–rata investments in ensuing rounds being optional case–by–case. Some form of follow–on funding can be provided as well. For example, Healthbox Europe has shaped an Angel Fund that acts as a co–investment fund to be invested alongside the accelerator as a separate legal entity.

Strategic focus

The second design element of an accelerator is the strategic focus. The strategic focus concerns the accelerator's strategic choices regarding industry, sector and geographical focus. The industry and sector focus ranges from being very generic (no vertical focus at all) to very specific (specialized in a specific industry, sector or technology domain). For example, Fintech Innovation Lab focuses exclusively on the financial sector, while L'Accélérateur is more broadly "retail-oriented". Overall, accelerators seem to be focusing their programs increasingly on certain themes rather than being generic.

In addition to an industry and sector focus, accelerators also have a geographical focus where they choose between being locally versus internationally active in their activities.

Techstars is an example of a program that initially focused on US only, but then internationalized to Europe with a program in London and Berlin. However, each local program operates autonomously, while Techstars as a whole aims to share best practice across its local units.

Selection process

Accelerators make use of a rigorous, multi-staged selection process. Usually, an open call is organized for a period of time, during which portfolio companies can register and apply online on a software platform such as F6S.com, Fundacity or Angel.co. Some programs, like Startupbootcamp and Climate–KIC, go one step further and actively scout startups during events before the application period.

Then, a standardized screening process is organized in which external stakeholders tend to participate. Different types of stakeholders are asked to sit in a selection committee or to do interviews. The portfolio companies are expected to present their ideas and they are screened in person. For example, Healthbox Europe uses a selection committee, which comprises of mentors, investors and alumni, to help shortlist companies in its program.

Remarkably, all accelerators in our sample claimed that teams are the main selection factor. Entrepreneurial teams are typically selected in batches and single founders are only selected by exception. A representative example is the screening process of the Paris–based accelerator TheFamily. Their application process is perceived to be "founder–friendly", since the team as opposed to the idea is the dominant decision factor for participation in the accelerator. Some accelerators will help founders with matchmaking and team formation, which is also of benefit to teams missing a specific skill set. For example, the Paris–based accelerator Le Camping organizes an event called "Adopt a CTO" before opening the call to submit applications. This event offers single founders the opportunity to find a CTO and form a team. Other accelerator programs such as Startupbootcamp and Climate–KIC have entrepreneurs–in–residence. These are entrepreneurs with a specific skill who can join entrepreneurial teams, become co–founders, or build their own companies. They are more than mere advisors (compared to mentors), as they work closely together with the teams and become team members. Some entrepreneurs-in-residence are paid, others participate in the program driven by the opportunity, experience or personal growth.

Funding structure

A fourth design element characterizing an accelerator concerns its funding structure. We find that most programs receive the major part of their working capital from shareholders. These

shareholders are either private investors, corporate companies or public authorities. Although most accelerators look to complement these sources with revenues, few of the accelerators we interviewed were able to get revenue from investments in the startups they support. Alternatively, this can also be because these programs are still relatively new and it will take some time before they have noticeable exits in their portfolio companies. Some accelerators diversify their model in order to source alternative revenue through the organization of events and workshops. For example, TheFamily organizes a lot of events, for which they sell tickets online, which has turned into a profitable event business.

Alumni relations

The last design element particular for an accelerator concerns its relations with alumni. The accelerators in the study put a lot of emphasis on keeping close and active relations with the companies that graduate from their program. Most accelerators run regular events for alumni and invite them back into the program to share their experiences where possible. These companies are used as reference cases and often get actively involved in the mentoring activities discussed above.

Some accelerators experiment with the extended provision of support services to alumni companies once graduated. Accelerators that take equity in their startups have an additional incentive for providing continued support to help their alumni succeed. Once an accelerator has developed over a number of years, the alumni network can be an important source for mentors and investors, as successful graduates are more likely to invest back into the community that supported them in the first place.

We conclude from our analysis that the five design elements – program package, strategic focus, selection process, funding structure and alumni relations – are the key building blocks of an accelerator model, as they appear in each of the 13 cases under study and allow parallels to be drawn and differences among the cases to be identified.

Design themes

Our data further reveals that the accelerators in our study vary in their architecture, depending on their approach to each of the design elements. In the next section we therefore describe the second set of design parameters that characterize an accelerator: its design theme. The accelerator's design theme is the common theme underlying a particular type of accelerator, orchestrating and connecting the different design elements (Zott & Amit, 2010). The accelerator design themes were identified through application of the "full context form" repertory grid technique during the interviews (see above) and a further cross-case analysis,

focused on revealing themes cutting across cases. As explained in the data analysis, our data revealed three distinct themes characterizing three different types of accelerator. Table 3 provides an overview of the different accelerator types, outlining the differences and similarities regarding the 5 design elements, and illustrates which cases belong to each group. In what follows we again describe each type of accelerator in detail.

Please insert Table 3 here

The "ecosystem builder"

The "ecosystem builder" is an accelerator typically set up by corporate companies that wish to develop an ecosystem of customers and stakeholders around their company. Large companies such as Microsoft and Accenture install or support an ecosystem builder accelerator in order to extend their network of stakeholders. The accelerator is used as a matchmaking device to connect lead customers with promising startups and in this way nurture the development of an ecosystem around the company. As an example, the accelerator FinTech Innovation Lab in London is run by Accenture. It has the primary aim to create a platform for the financial services industry to collaborate on innovation with early–stage ventures. With this, Accenture seeks to strengthen its relationship with banking clients and increase its foothold in the market. Similarly, one of the drivers of the Microsoft Ventures Accelerator is to support startups whose solutions will benefit Microsoft's vast SME customer base across Europe.

The ecosystem builder accelerator actively involves its corporate stakeholders in the accelerator's operations. For example, senior executives of the corporate are often involved in the selection process of portfolio companies. Hence, only those ventures that attract the attention of the corporate's executives and that will be able to enhance the corporate's ecosystem development are selected. Mentors are often sourced from the corporates as well. These corporate mentors help the startups to find their way through the internal decision–making system of the company. Interestingly, this type of accelerator most often has no profit orientation and offers no investment to the startups that participate in the program. Instead, these accelerators add value to the portfolio companies, primarily by helping them to connect with potential customers. The accelerator's network is therefore almost exclusively oriented towards the potential customer base. They are financed on a yearly basis by the corporate and often adopt soft performance measures. They frequently engage in symbolic actions such as

broadcasting, newsletters, and showcase events, to illustrate their legitimacy in the absence of strict key performance indicators (Zott & Huy, 2007).

The "deal-flow maker"

The "deal-flow maker" accelerator receives funding from investors such as business angels, venture capital funds or corporate venture capital and has the primary aim to identify promising investment opportunities for these investors. This accelerator type resembles most of the original concepts of Y Combinator and Techstars developed in the US. Its objective is to bridge the equity gap between early–stage projects and investable businesses.

The deal-flow maker typically provides some form of seed financing to the portfolio companies in exchange for equity. The screening criteria in these programs tend to favor ventures that are eligible for follow-on capital and have the ability to evolve in attractive investment propositions. The mentors used in these accelerators are often active business angels themselves, who play a further role in follow-up investments. The director of Fintech Innovation Lab described the mentors of deal-flow makers as "investors in disguise".

Deal-flow maker accelerators tend to select ventures, which already have some proven track record or in some cases have already raised pre–seed finance. They hence focus on startups that are in the later stages of development and often choose to specialize within a specific industry. By focusing on one specific sector, the accelerator management team can develop the necessary sector–specific knowledge and expertise to identify and exploit the economic potential of entrepreneurial teams.

The "welfare stimulator"

The "welfare stimulator" accelerator typically has government agencies as a main stakeholder. The primary objective of this type of accelerators is to stimulate startup activity and foster economic growth, either within a specific region or within a specific technological domain. For instance, the European Commission supports the establishment of accelerators within particular technological domains of its economic development program (i.e. Knowledge and Innovation Communities or KICs).

The selection criteria and processes used in these accelerators are oriented towards attracting companies that fit within the vision of welfare creation. For example, the Paris–based accelerator Scientipôle Initiative promotes its program to unemployment agencies in order to encourage unemployed entrepreneurs to apply to the accelerator. It focuses heavily on the potential for job creation in its selection criteria.

Welfare stimulators typically select ventures in a very early stage. Quite often a value proposition has not yet been developed. As a consequence, the curricula and training programs provided by welfare stimulators are most developed among the three types of accelerators. Welfare stimulators typically organize training sessions, workshops and practical learning–oriented events to help the ventures develop their idea and value proposition. The accelerator's mentors are closely involved with the portfolio companies and provide hands-on guidance and advice. In some cases mentors are consultants or business developers, who – often on a paid basis – help to commercialize the technology or sell the product/service idea.

However, for a lot of welfare stimulator accelerators, the business model is rather unclear, as most public sponsors require some form of revenue after an initial financing period. Although most welfare stimulator accelerators present the typical investment model as a potential, others experiment with other forms of revenues such as tuition fees or registration fees for particular training courses.

The above findings suggest that the accelerator design themes are determined by the objectives of the affiliated shareholders (respectively corporates, investors and government agencies). The objectives of these shareholders; building a company ecosystem in the case of corporates, identifying interesting investment opportunities in the case of investors and stimulating startup activity and economic development in the case of government agencies, are translated into the primary objective of the accelerator and represent the common theme orchestrating and connecting the accelerator's different design elements.

However, our data also point to the existence of hybrid accelerator types, which incorporate characteristics of two different accelerator types. For examples, the London-based accelerator Bethnal Green Ventures combines characteristics of the deal-flow maker and welfare stimulator. The accelerator receives funding from the UK Cabinet Office, Nominet Trust and Nesta and runs like a traditional deal-flow maker accelerator in many aspects. It focuses on high-potential technology startups and invests up to £15,000 in exchange for 6% equity. However, Bethnal Green Ventures also has a strong social dimension. It is a strong advocate of "Tech for Good" and exclusively focuses on companies that leverage products and services for social good. In addition to financial support it plays an important role in hosting meetings and events in order to build a social community around the portfolio companies and foster economic welfare creation.

DISCUSSION AND IMPLICATIONS

This study extends previous incubation research by delineating the accelerator model as a new generation incubation model, by revealing the distinctive features of the accelerator model and identifying the heterogeneity of accelerator strategies and operations. The extant incubation literature already identified a number of descriptive characteristics of incubation models, resulting in a variety of typologies and classifications, but, so far, failed to provide systematic evidence about whether these insights hold for accelerators as well (Hackett & Dilts, 2004). Moreover, it lacks a consistent theoretical framework to define and assess different generation incubation models in order to account for the heterogeneity among incubation models and keep track of incubation model evolution. This study addresses these gaps and thereby provides important implications for both theory and practice.

Theoretical implications

Against a background of sparse research about accelerators, our study has several implications for research on incubation models in general and research into the accelerator model in particular.

First, we respond to the call in extant incubation research to take the heterogeneity among incubation models into account by delineating the accelerator model as a new generation incubation model, by identifying its key design parameters and by shedding light on the heterogeneity within the accelerator model. We show that accelerators are different from other incubation models in five aspects (program package, strategic focus, selection process, funding structure and alumni relations) and highlight the objectives of the accelerator's shareholders as the main driver orchestrating an accelerator's activities. By identifying three different groups of accelerators, we further contribute to the request from incubation scholars to take different types of incubation models and their specific features into account in order to assess performance (Barbero et al., 2014; Mian, 1997).

Second, our results show that accelerator programs adopt different ways of structuring and running their programs, and that this is largely determined by the objectives of their key shareholders. Although most accelerator managers in our study mentioned Silicon Valley based accelerators Y Combinator and Techstars as sources of inspiration, many of them do not adopt a pure deal-flow maker model. We find two other types (the ecosystem builder and the welfare stimulator) prevalent in Europe. The three accelerator types differ in satisfying different shareholder needs (respectively those of investors, corporates and public agencies). As a consequence, the deal-flow maker focuses heavily on mentoring by serial entrepreneurs and

business angels, who know how to create legitimacy for follow-up investments. This is in line with Kim and Wagman (2014), who suggest that accelerators act as certification intermediaries, providing information and services (e.g. screening practices and mentoring) valued by outside investors to help their portfolio ventures raise new capital. The ecosystem builder is mainly focused upon helping ventures through the complex decision-making structures of corporate companies. Instead of mentors, internal members of the corporates are used to support and guide the portfolio companies.

Finally, the welfare stimulator tends to be more program-led by providing intensive workshops and training sessions to help the ventures find their way to first customers. With this finding, we highlight shareholder objectives as important design parameters to take into account, in addition to those of the portfolio companies participating in the accelerator. Previous research has argued that the variety of incubation models is driven by the evolution of portfolio companies' requirements and needs, which encourage incubation mechanisms to differentiate the range of services that they offer. However, our evidence leads us to argue that differentiation between accelerators is driven by additional factors. Specifically, from our qualitative evidence we theorize that differences in the objectives of shareholders supporting or financing the accelerator will lead to differences in the way accelerators run their programs. Although portfolio companies' objectives do impact the design of an incubation model (after all, changing portfolio companies' needs gave rise to the accelerator model in the first place), our study highlights the importance of other stakeholder objectives, especially those stakeholders supporting and/or financing the accelerator, to explain heterogeneity among different accelerator model designs.

Third, by introducing a design lens to look at the accelerator model, we contribute to recurrent requests in incubation research to develop more theoretically grounded approaches to analyze incubation activities (Bruneel et al., 2012; Hackett & Dilts, 2004). We propose the activity system design perspective, highlighting design elements and themes as important design parameters to take into account, as an adequate theoretical lens to study incubation models and their evolution. The design lens offers a structured way to identify the key building blocks of the incubation model, enables classification of different incubation models, as well as allows heterogeneity within the model to be taken into account. Moreover, an additional advantage of this framework is that it allows accounting for hybrid models. Within our sample, we note that two accelerators have hybrid models. Bethnal Green Ventures has a clear welfare stimulation focus but nevertheless copies the mentorship model typically present at the deal-flow maker model, while Healthbox has a clear ecosystem building focus but also provides

some capital to its startups (see also table 3). The introduction of a design lens in incubation research embodies rich possibilities for further theoretical development and refinement. It not only gives researchers a concrete tool to study incubation models and their evolution but also brings the importance of design thinking, i.e. the design of an incubation model is seen as a key decision in the creation of an incubation entity, to the forefront of incubation research.

Managerial and policy implications

The accelerator design elements and themes identified in this study can be used to position different accelerators within the overall ecosystem. We suggest that initial advisors to early–stage ventures (e.g. government support agencies; university student and alumni entrepreneurship offices) should consider the different accelerator design elements and themes in order to orient nascent entrepreneurs towards particular types of accelerators that may best meet their needs.

The diversity of accelerators we have identified also has implications for policymakers in supporting different types of accelerators and evaluating their role. Rather than evaluating the effectiveness of an accelerator using using a fixed set of criteria, there is a need to develop measures that take into account the different objectives of different types of accelerators. Policymakers typically have specific objectives, such as regional development and employment. Taking these objectives into account, policymakers have to realize that the accelerators they finance might not necessarily be profitable in the short or even medium term. The ventures they invest in, the program they have to develop and their strategic focus do not always allow this. The systematic research evidence is sparse, but only deal-flow maker accelerators in very dense ecosystems such as Silicon Valley appear to have a proven business model. Unfortunately, we often see that policymakers expect welfare stimulators to have similar outputs as deal-flow makers.

As accelerators have grown in popularity, many nascent entrepreneurs and organizations such as universities, companies and regional development agencies feel attracted to the idea of starting an accelerator. Universities see it as a way to promote student entrepreneurship, companies as a way to tap into startup innovation and talent, and development agencies as a way to create employment. Examples of university–led accelerators include “Beta Foundry” at Oxford University, InnovationRCA at the Royal College of Art and the pre–accelerator “Imperial Create Lab” at Imperial College, London. Our research shows that starting an accelerator needs a clear vision and strategy, and a good fit between the different design parameters and the objective one wants to achieve with the accelerator. Given the results

so far, it seems unlikely that accelerators will be profitable or even sustainable without continued financial support for a number of years. Although accelerators play an important role, the need for this type of support needs to be legitimate. If not, the accelerator initiatives will disappear as soon as the financial support for them decreases.

Finally, our findings suggest that accelerators may help solve some of the problems associated with previous generation incubation models. Earlier, some incubation models have been accused of merely acting as life support and keeping tenants alive in order to secure rent and fill their incubation space. As most accelerators invest in their startups the accelerator model has an added incentive to make sure that the selected startups survive and scale. Accelerators are a way to shorten the journey of startups, resulting in either quicker growth or quicker failure. However, as some accelerators do allow alumni to remain in the space after the program has ended, we have to take into account the potential of creating adverse consequences if not time limited.

Limitations and future research

As all studies, this study is not without limitations. This final section aims at outlining the particular limits of this study, which provide interesting avenues for further research. First, the paper is based on accelerators located in the three leading accelerator regions in Europe: London, Paris and Berlin. These different European regions imply different contexts in which accelerators need to function and be sustainable. However, these three regions may not be representative of all types of regions in Europe. As spatial context may have an important influence on entrepreneurial and innovation ecosystems (Levie, Autio, Acs, & Hart, 2014), further research is needed to test our findings in similar regions in other countries and in different environments in general. Moreover, further research is needed to examine the influences of policy, industry, density and economic conditions on the configuration of different accelerator types in a particular region.

Second, as accelerator programs develop, our framework, highlighting the accelerator's key design parameters, can serve as a basis for more rigorous evaluations of accelerator performance and can be used to define suitable success metrics in achieving certain objectives. Subsequent analyses might also usefully examine the challenges faced by particular accelerators as they evolve over time into different models, depending on the success of their initial configuration.

Third, whilst beyond the scope of this paper, which has focused on the accelerator as a unit of analysis, the study of the impact of different accelerator types on their portfolio

companies might be an interesting avenue for further research as well. The approach used by the accelerator is likely to have an impact on the entrepreneurial journey of startups and on the value added to them. Further research on the differences between different accelerator types and their impact on the entrepreneurial process would be interesting, as this would enable identification of best practices with the aim of implementing a customized acceleration strategy to propel startups.

Finally, in order to truly gauge the effectiveness of different models there is a need for studies that compare accelerated ventures to a control group of non-accelerated ventures in order to provide robust insights into the contribution of accelerators. Furthermore, as decision makers perceive a focus on one sector or technology as an interesting strategic option, assessment of differences in effectiveness and value-added contributions to the startups can improve our understanding of the possible benefits of specialist versus generalist accelerators.

CONCLUSION

Accelerators play an important role in stimulating entrepreneurship. However, prior research has provided only limited insight into their distinctive features and the heterogeneity of their strategies and operations. Against a background of sparse prior research, this study has produced several interesting results about an accelerator's key design parameters that have novel implications for the incubation literature and practice. Obviously, because the phenomenon is so new, uncertainty still exists about the future success of accelerators. What is undeniable, though, is the compelling economic logic of such organizations. We hope that the findings of our study will open the way for further systematic analyses of the processes and impacts of accelerator programs.

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Table 1: Case descriptives

	Name	Acronym	Location	Founding date	Program length	Investment size	Equity stake taken
1	*Techstars London*	TL	UK, London	2013	3 months	£12500 + option conv. loan	6%
2	*Healthbox Europe*	HB	UK, London	2012	4 months	£50000	10%
3	*Fintech Innovation Lab*	FIL	UK, London	2012	3 months	/	/
4	*Bethnal Green Ventures*	BGV	UK, London	2011	3 months	£15000	6%
5	*Climate-KIC Europe*	CKE	Europe	2010	12-18 months	max. of €95000	/
6	*Microsoft Ventures Accelerator*	MVA	Germany, Berlin	2013	4 months	/	/
7	*Axel Springer Plug & Play Accelerator*	ASPP	Germany, Berlin	2013	3 months	€25000	5%
8	*ProSiebenSat.1 Accelerator*	PSSA	Germany, Berlin & Munich	2013	3 months	€25000	5%
9	*Startupbootcamp Berlin*	SBC	Germany, Berlin	2012	3 months	€15000	8%
10	*Le Camping*	LC	France, Paris	2010	6 months	€4500	/
11	*TheFamily*	TF	France, Paris	2013	indefinite	/	3%
12	*L'Accélérateur*	LA	France, Paris	2012	4 months	€10000 + option for more	7-10%
13	*Scientipôle Initiative*	SI	France, Paris	2002	6 months	€20000 - 90000	/

Table 2: Data structure supporting accelerator design elements

Design elements	Constructs	Representative quotes
PROGRAM PACKAGE	*Mentoring services*	"80-100 individuals in our mentor network" [HB, Nov 2013] "The mentor model came from Techstars US. Mentors are heavily involved in the program." [BGV, Oct 2013] "Startups are given feedback all the time, there is a structured feedback process regarding partners and mentors." [MVA, Dec 2013) "We meet every mentor face-to-face and kind of have a debrief or pre-brief." [SBC, Dec 2013] "The only method that we found that works is: rent a room in a restaurant, bring in food and a lot of alcohol and close the doors, and in 4 hours magic happens" [MVA, Dec 2013] "First month is mentor-heavy, with matchmaking and presenting and speed dating…" [SBC, Dec 2013] " We have intern mentors, so from within the company, that have expertise in a certain area." [PSSA, Nov 2013] "We have godfathers... They are actually internal coaches from Axel Springer. So we match them with the teams." [ASPP, Dec 2013]
	Curriculum / training program	"We have like lawyers, accountants, and HR people that also offer their services to our startups through workshops, lectures or office hours. Then we have some lectures that inspire them." [MVA, Dec 2013] "…fixed curriculum points they have to, or should attend. And those are sessions with internal and external mentors and coaches, with experts, with entrepreneurs, with people from the team where they learn things about specific functional topics." [PSSA, Nov 2013]
	Counselling services	"We check with the companies at least weekly if not twice a week so we do have regular conversations." [HB, Nov 2013] "We also do a kind of weekly stand-up. On Friday they have to stand in front of the class explaining what they did last week and what they want to achieve." [MVA, Dec 2013] "We set up an action plan and use the cash to address the bottlenecks. To identify the bottlenecks, you need to sit around the table for hours, maybe days… Then we have to follow-up by visiting the guy (~ founder) step-by-step." [KIC, Dec 2013]
	Demo days / Investor days	"Our Demo Day is slightly different. It is not about getting investors in the room, it is actually getting customers in the room for the companies." [HB, Nov 2013] "The majority of people we invite for the Investor Day are investors and they could be angel investors, VC's, private equity investors…" [FIL, Nov 2013]
	Location services	"Free office space here, free Wi-Fi, free stunning view, free drinks." [MVA, Dec 2013] "We ask them to come to London and we provide them with desk space and office space." [FIL, Nov 2013]
	Investment opportunities	"The deal is 100% standardized because we don't have time to negotiate with the teams… so we take 5% of equity in the companies and we give them €25,000 plus our mentoring, coaching and the office space." [PSSA, Nov 2013] "We invest some cash in the beginning. Between 5 and 15K. But if we believe that the companies are in the right track and need some money then we will invest between 500 and 200K and we usually take between 7-12%." [LA, Nov 2013] "So we have $120,000, $20, 000 dollars goes for 6% plus the program, plus all the freebies which are not insignificant. And alongside that the teams get $100,000 on a note, convertible note." [TL, Jan 2014] "After graduation, we have the discretion of writing the 150,000 check. The alternative, which we do use a lot, is we basically say we will co-match." [TL, Jan 2014] "We can do follow-up investments… if anyone comes and says like 'I like them' and he invests, we can give the other 50%. So we can mirror the investment." [ASPP, Dec 2013]

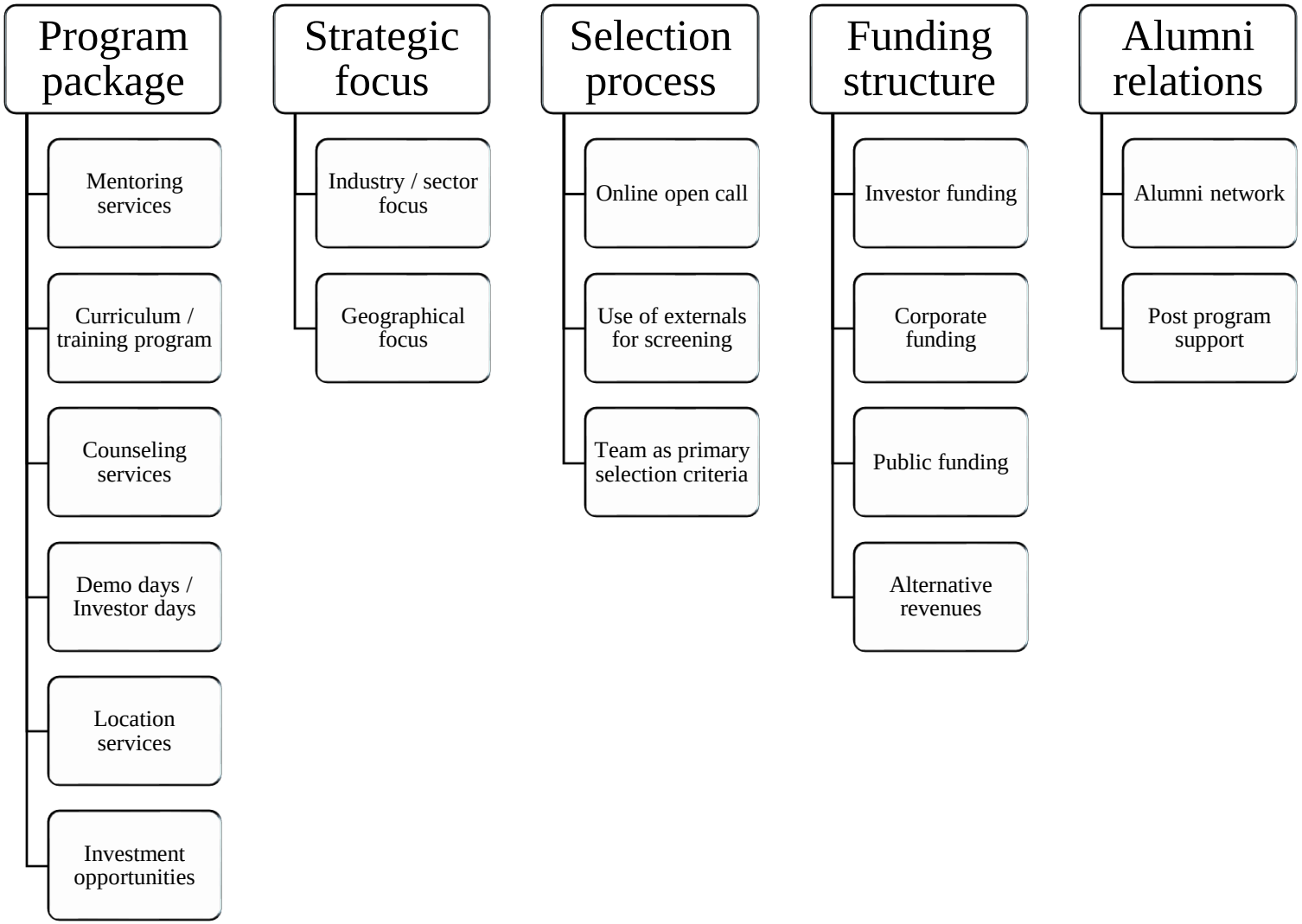
STRATEGIC FOCUS	*Industry / sector focus*	"Nesta's investment themes… health, education and sustainability" [BGV, Oct 2013] "We are an open thematic accelerator" [LC, Jan 2014] "We customized that model to be more reflective of the healthcare market and our interest in exploiting that area." [HB, Nov 2013]
	Geographical focus	"90% of our businesses are in the US and 10% is not... I used to run a stand-alone program and it would have been hard to differentiate myself." [LC, Jan 2014] "The London program is very much based on the New York program that we have" [FIL, Nov 2013] "There are these that are considered innovative enough since we only fund innovative projects that are less than 3 years old and are in the region of France." [SI, Dec 2013]
SELECTION PROCESS	*Online open call*	"We have an application phase that is open for about 4-6 weeks. During these 4-6 weeks we ask companies to submit and to fill in a questionnaire" [PSSA, Nov 2013] "We open the online platform for two months. So future applicants have two months to register and to complete their applications" [LC, Dec 2013]
	Use of externals for screening	"We shortlist companies with the help of members of the selection committee who are representative of the mentors and some of the investors of the program" [HB, November 2013] "We use alumni a lot when screening, especially if the idea is in line with their area of expertise... I even let them do interviews. And we do have a selection committee – they are involved in the selection days" [SBC, Dec 2013] "The banks meet the startups and they interview them" [FIL, Nov 2013]
	Team as primary selection criterion	"We learned that selecting teams remotely is difficult, we want to see them face-to-face, in action" [SBC, Dec 2013] "We do a final panel interview which we do in person rather than Skype, because we want to meet the team" [TL, Jan 2014] "We have a focus when we look at selection: team, team, team and opportunity" [TL, Jan 2014] "We have like 3 important criteria: the team, degree of innovation and market opportunity" [LC, Nov 2013] "We look at personal qualities (ambition, tenacity, frugality, openness, flexibility) and strong teams which interact well" [LA, Nov 2013]
FUNDING STRUCTURE	*Investor funding*	"We are privately funded mostly by business angels and a couple of VC's" [SBC, Dec 2013] "Our investors are either all professional investors or VCs or angels. And we cap the amount of money that any investor can put into our fund. Because we actually want diversity in our investor base rather than 1 person turning up and say 'here is half the money'. So I tend to use it much more aggressively than some others do to create a network of smart investors" [TS, Jan 2014]
	Corporate funding	"Accenture covers the operating costs" [FIL, Nov 2013] "Then you have the ones that are corporate funded (like us), which is typically a prerequisite for providing a good program that will last for a longer period of time" [PSSA, Nov 2013] "There is no partner funding, so this is all Microsoft funded. There is no partnership with any organisation. I am a 100% Microsoft employee, this building is financed by Microsoft." [MVA, Dec 2013].
	Public funding	"It is a non-profit association and it is a sponsorship. So we receive some money and we allocate it, this money, to our events and our place" [LC, Nov 2013] "Wayra UnLtd is, like us, funded from the Cabinet Office… We have a non-profit part which owns the majority of Bethnal Green Ventures LLP" [BGV, Oct 2013]
	Alternative revenues	"Actually we have a very profitable event business. We are organising a lot of events and people like our events. So we know how to sell tickets online, it is a good way to gain money, the event business is an incredible business with capital" [TF, Nov 2013] "Startupbootcamp Berlin is renting out desks in our new co-working space called the Startup Gallery" [SBC, Dec 2013]

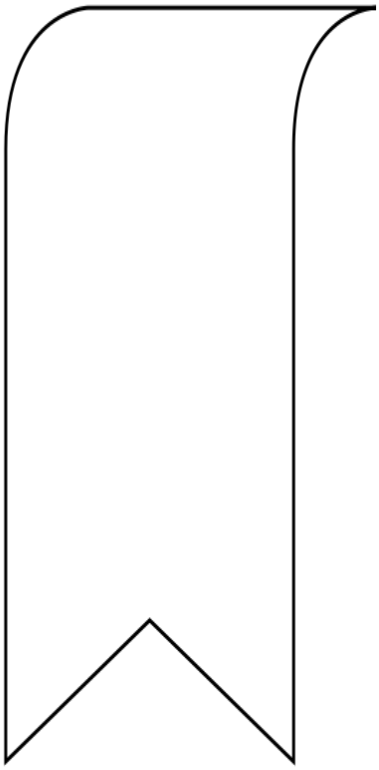
ALUMNI RELATIONS	*Alumni network*	"We build the infrastructure to try to help them… We run alumni-events quite often and alumni are invited back in for all the program stuff when we run a program. So we create a lot of opportunities for them" [BGV, Oct 2013] "We have an alumni annual meeting where we bring as many alumni as possible together. And they just share what is going on and they connect from across the programs" [SBC, Dec 2013]
	Post program support	"Our program runs from October to January but we continue to offer office space until past September. So it is one less thing for the companies to worry about because, you know, office space in London is extremely expensive. So we continue to make introductions and continue to support the companies where we can. Obviously it is not as hand-on as it was during the program but there is additional support" [HB, Nov 2013] "We don't kick the alumni out of our space, why would we? And we run monthly alumni events in London. There is one tomorrow, every first Thursday of every month. We have it in the same space all the time" [TL, Jan 2014]

Table 3: Data structure supporting accelerator design themes

	ECOSYSTEM BUILDER	DEAL-FLOW MAKER	WELFARE STIMULATOR
Design theme	**"Matching customers with startups and build corporate ecosystem"**	**"Identification of investment opportunities for investors"**	**"Stimulation of startup activity and economic development"**
Program package	Mentoring provided by internal coaches from corporates No seed investment or equity engagement	Mentoring provided by serial entrepreneurs and business angels Standard seed investment and equity engagement	Mentoring provided by serial entrepreneurs and business developers; most extensive curriculum Mostly seed investment and equity engagement
Strategic focus	Mix of generalists and specialists International focus	Mix of generalists and specialists Local and/or international focus	Mostly generalists Local and/or international focus
Selection process	Favour new ventures in later stages with some proven track record	Favour new ventures in later stages with some proven track record	Favour very-early stage new ventures
Funding structure	Funding from corporates	Funding from private investors (business angels, venture capital funds and/or corporate venture capital);	Funding from local, national and international schemes; experimenting with funding structure and revenue model (search for sustainability)
Alumni relations	Establish infrastructures to build alumni services	Establish infrastructures to build alumni services	Establish infrastructures to build alumni services
Cases	**Fintech Innovation Lab** **Microsoft Ventures Accelerator**	**Techstars London** **TheFamily** **Startupbootcamp Berlin** **ProSiebenSat.1 Accelerator** **Axel Springer Plug & Play Accelerator** **L'Accélérateur**	**Climate-KIC Europe** **Scientipôle Initiative** **Le Camping**
	Healthbox Europe		**Bethnal Green Ventures**
Representative quotes	*"It is more a service to strengthen our relationships with the banks" [FIL, Nov 2013]* *"With Microsoft you have unparalleled access to customers, because we are still relevant and big in every small and midsize enterprise." [MVA, Nov 2013]*	*"The goal is to generate positive returns from our investments" [PSSA, Nov 2013]* *"We do it because we really would like to have a good investment case… So when I look back in 8 years, I would like to have two big exits because then everything we did here is fine. We help them with contracts, follow-up investment, so we are also investment bankers." [ASPP, Nov 2013]* *"We want to create more exit opportunities… we are privately funded by investors" [SBC, Nov 2013]*	*"Get the economy going with social impact startups. It's not just about investing in startups" [BGV, Oct 2013]* *"The most important thing is to create sustainable startups in the long term… about 200 jobs have been created" [LC, Dec 2013]*

Fig 1: Design elements and constructs





STUDY 2

(this study consists of two essays)

ESSAY 1 – REVOLUTIONIZING ENTREPRENEURIAL ECOSYSTEMS THROUGH US AND EUROPEAN ACCELERATOR POLICY

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ABSTRACT

Policymakers are one of the key stakeholders in the entrepreneurial ecosystem in which accelerators are embedded. After a glance at the US policy towards accelerators, the main focus of the study lies on how currently EU policy engages with different stakeholders in order to support accelerator activity within the EU area. The EU interactions with accelerators are threefold: (i) the EU supports the setup of accelerator networks to create momentum for accelerators to meet, exchange experiences, expertise, and knowledge (e.g. Accelerator Assembly); (ii) the EU supports and funds accelerator programs (e.g. EU-XCEL-European Virtual Accelerator, IoT Accelerator Programme, Copernicus Accelerator Programme); (iii) accelerators serve as intermediaries between the EU and startups looking for funding (e.g. EuropeanPioneers, Climate-KIC accelerator UK) in addition to the SME funding instruments of the EU (e.g. SME Instrument). Examples of each of these initiatives are discussed in more detail.

Key words: funding for accelerators, European Commission's Entrepreneurship 2020 Action Plan, policy implications

INTRODUCTION

European policies towards accelerators need to be seen as part of the attempts by the European Union (EU) to build and sustain global competitiveness by stimulating entrepreneurship, primarily science and technology based. These policies tie into a worldwide rise in interest by political leadership to address the building of science and technology based knowledge regions to enhance national economic competitiveness, particularly outside the USA (Mian, 2011). EU policies aimed at fostering the creation of technology (or knowledge) based firms are often perceived as a response to the US capacity to transform knowledge into new high-tech and high-growth firms. However, much of the US context that European policymakers have sought to emulate involves atypical high-tech clusters which seem to be absent from Europe (Mustar & Wright, 2010). Direct transfers of policy between US and Europe are therefore challenging because of the need to take into account the unique circumstances of high-tech clusters' history and surrounding communities.

Over the years, the EU has launched several new initiatives to foster entrepreneurship. The European Commission's initiatives promoting entrepreneurship are summarized in the Entrepreneurship Action Plan[16] adopted in January 2013. The aim is to reignite Europe's entrepreneurial spirit by: (i) educating young people about entrepreneurship; (ii) highlighting opportunities for women and other groups; (iii) easing administrative requirements; and (iv) making it easier to attract investors. The shift toward targeted policies to support high-growth entrepreneurship is identified as an important development in the public policy arena (Autio, 2007). Recent polices to reinforce accelerator activities tie into this trend as accelerator programs target and source these high-growth entrepreneurs. Many governments have adopted a focus on high-growth firms, having learned that only a small fraction of all new firms is responsible for creating the majority of new jobs (Bravo-Biosca & Westlake, 2009; Acs, Szerb & Autio, 2016). As the output, entrepreneurial ecosystems produce is high-growth new ventures (Acs et al., 2016a) and accelerators have become pivotal in the entrepreneurial ecosystem in which they are embedded, and are perceived as gateways for early-stage ventures, the development of an EU policy towards accelerators needs to be seen as part of its policy towards entrepreneurial ecosystems.

The EU encompasses a range of different institutional settings, informal and formal, different cultures, norms and values and attitudes toward entrepreneurship that effects the

[16] https://ec.europa.eu/growth/smes/promoting-entrepreneurship_en
(last consulted on 4/8/2016)

nature of entrepreneurial ecosystems (Autio, Kenney, Mustar, Siegel & Wright, 2014). Given that ecosystems comprise multiple participants bound by complex relations that often involve mutual interdependence, policy to stimulate and sustain entrepreneurial ecosystems needs to be aligned with the relevant context (Acs, Audretsch, Lehmann & Licht, 2016). High-growth new ventures, as outputs of entrepreneurial ecosystems, are coproduced through a myriad of usually uncoordinated interactions between hierarchically independent yet interdependent stakeholders (Acs et al., 2016a). Therefore, policymakers need to engage the various stakeholders and co-opt them as active participants and contributors to policy intervention.

This study focuses on how currently EU policy engages with different stakeholders in order to support accelerator activity within the EU area. It should not be seen as an exhaustive overview of all the EU policies aimed at stimulating and supporting entrepreneurship in accelerators but should rather be read as exemplary, highlighting the most relevant and recent EU initiatives aimed at fostering accelerator activity. This provides policy makers a compass to help them answer the question: *What has been the role of EU public policy over time to support accelerators?* We screened the web systematically using the following key words: (1) "business accelerator", "startup accelerator", "seed accelerator", "startup", "young firm", "new venture", "Europe", "USA", "policy", to identify relevant studies and reports. We also identified additional articles through manual cross-referencing. We specifically looked for policy instruments that support (in-) directly accelerators, as well as those that implement accelerator models to support entrepreneurs. In some cases, the business press was a valuable source of information. As interest in the US model of technological entrepreneurship is not new in Europe, this study commences with a glance at the US policy towards accelerators to explore whether there is any difference in approach.

GOVERNMENTAL SUPPORT FOR ACCELERATORS IN THE USA

Since accelerators originated in the USA, it is the first place to look for any kind of government policy aimed at accelerators. One distinctive funding program, aimed to fill geographic gaps in the accelerator and entrepreneurial ecosystem scene, is considered here as exemplary.

In 2014, the US Small Business Administration[17] (SBA) launched the first ever Growth Accelerator Fund Competition. The competition was designed to award select accelerator and incubator models[18] funding for their operating budgets worth of $2.5 million in cash prizes.

[17] https://www.sba.gov/offices/headquarters/ooi/resources/1428931 (last consulted on 1 June 2016).
[18] For the purpose of this competition, Growth Accelerators include accelerators, incubators, co-working startup communities, shared tinker-spaces or other models to accomplish similar goals.

832 entities submitted applications from every state (except Alaska, but including Washington DC and Puerto Rico). Accelerators and other entrepreneurial ecosystem models competed for awards of $50,000 each. 100 finalists were whittled down by a panel of experts and 50 winners were selected. Of the 50 winners 7 were in rural America and 9 were launching a new accelerator model. 20 winners were active in general activities, 18 in science and technology, 5 in healthcare, 3 in manufacturing, 3 in education, 3 in agricultural, 3 in food and beverage, 2 in biotechnology, 2 in energy, and 2 in tourism. Those 50 winners are an ecosystem made up of about 1,500 geographically dispersed startups across a broad array of industries that employ close to 5,000 people and have collectively raised over $600,000,000.

Based on that success, SBA ran a second instalment of the competition in 2015[19] with $4 million in Congress appropriated funds in support for accelerators in 39 states (plus Washington DC and Puerto Rico). The 80 accelerators selected as winners in the Growth Accelerator Fund receive $50,000 each in cash from the SBA. The competition intentionally focused on increasing awareness and providing funding to "parts of the country where there are gaps in the entrepreneurial ecosystem". Additionally, in 2015, SBA's Office of Native American Affairs (ONAA) used this competition's framework to award an additional $400,000 to ecosystems primarily dedicated to Native American entrepreneurs and small businesses.

For its 2016 edition more federal partners were included, such as the Office of Veterans Business Development, National Institutes of Health (NIH), National Science Foundation (NSF), Department of Education (DoED) and Department of Agriculture (USDA), to award additional prizes to accelerators that assist entrepreneurs with submitting proposals for the Small Business Innovation (SBIR) and Small Business Technology Transfer (STTR) programs. SBA's Office of Investment and Innovation (OII) is also partnering with the Inter-American Development Bank to provide prizes to US accelerators that assist the African descendant startup-up community in Latin America and the Caribbean. For its 2016 edition special consideration was also given to any accelerator model that supports manufacturing and the White House Power Initiative, because they are considered critical to job growth and strengthening the nation's economy[20]. 68 winners[21] of SBA's third annual Growth Accelerator Fund Competition were awarded a total amount of $3.4 million in prizes to boost the economic impact of accelerators across 32 states and the District of Columbia.

[19] http://www.kauffman.org/blogs/policy-dialogue/2015/august/accelerators-across-us-get-4-million-from-sba (last consulted on 1 June 2016).
[20] https://www.sba.gov/about-sba/sba-newsroom/press-releases-media-advisories/sba-launches-3rd-annual-growth-accelerator-fund-competition-award-395-million-small-business (last consulted on 21 December 2016).
[21] https://www.sba.gov/offices/headquarters/ooi/resources/1428931 (last consulted on 22 December 2016).

To award the prizes, several panels composed of over forty judges considered each applicant's stated mission, founding team members, and business goals, among other core components. The panel gave particular attention to, and the SBA encouraged, applicants that fill geographic gaps in the accelerator and entrepreneurial ecosystem scene. The most successful accelerators to date can be found on the coasts. Through this competition, SBA is looking to support the development of accelerators and startups in parts of the country where there are fewer conventional sources of access to capital, such as venture capital and other types of investors. This policy measure and its intended effect have recently been endorsed by scholars (Hochberg, 2015) showing that accelerators positively impact early stage financing in the region (regardless of their direct effect on the limited number of companies that take part in these programs). In addition to accelerators that fill the gaps as indicated above, they also sought out accelerators that are run by and support women or other underrepresented groups to help increase Native-American-owned, veteran-owned, women-owned and minority-owned small businesses.

EU's POLICY TOWARD ACCELERATORS

The evolution of accelerators in Europe is attracting policy support from the EU. For any member state of the EU, European policy adds an additional layer of policy on top of national, regional or local policies (as extensively discussed in the essay 2 by Van Hove, Vanaelst and Wright).

The Entrepreneurship 2020 Action Plan[22] is the European Commission's answer to challenges brought by the gravest economic crisis in the last 50 years. It is presented as a blueprint for action to unleash Europe's entrepreneurial potential, remove existing obstacles, and revolutionize the culture of entrepreneurship in the EU. It aims to ease the creation of new businesses and to create a much more supportive environment for existing entrepreneurs to thrive and grow.

Startup Europe contributes to the Entrepreneurship 2020 Action Plan. The European Commission's Startup Europe[23] initiative was created to foster tech entrepreneurship by connecting tech entrepreneurs across Europe, providing networks, resources and information to help them startup their business and grow, creating new jobs and transforming the economy and society. Startup Europe's objectives are: (i) to reinforce the links between people, business

[22] http://ec.europa.eu/growth/smes/promoting-entrepreneurship/action-plan/index_en.htm (last consulted on 5 July 2016).
[23] https://ec.europa.eu/digital-single-market/en/startup-europe (last consulted on 5 July 2016).

and associations who build and scale up the startup ecosystem (e.g. the Web Investors Forum, the Accelerator Assembly, the Crowdfunding Network, etc.); (ii) to inspire entrepreneurs and provide role models (e.g. the Leaders Club and their Startup Manifesto, the Startup Europe Roadshow); (iii) to celebrate new and innovative startups (with Tech All Stars and Europioneers), help them to expand their business (e.g. Startup Europe Partnership), and give them access to funding under Horizon 2020.

In what follows only those initiatives taken by the EU to strengthen entrepreneurial activity with a main focus on accelerator activities[24] are considered. Some of these initiatives were promulgated under the EU's Seventh Framework Programme (e.g. the ATALANTA project and the European Accelerator Summit, the FIWARE project and EuropeanPioneers) while others developed under the more recent Entrepreneurship 2020 Action Plan. The ways in which the EU interacts with accelerators can be interpreted as a confirmation of the recognition of the pivotal role of accelerators in entrepreneurial ecosystems. These interactions are threefold: (i) the EU supports the setup of accelerator networks to create momentum for accelerators to meet, exchange experiences, expertise, and knowledge (e.g. Accelerator Assembly); (ii) the EU supports and funds accelerator programs (e.g. EU-XCEL-European Virtual Accelerator, IoT Accelerator Programme, Copernicus Accelerator Programme); (iii) accelerators serve as intermediaries between the EU and startups looking for funding (e.g. EuropeanPioneers) in addition to the SME funding instruments of the EU (e.g. SME Instrument). Interesting examples of each of these initiatives will be discussed in more detail below.[25] Table 1 presents an overview of the examples discussed of EU funded accelerator activities.

[24] Taking a narrower delineation than in the exemplary case of the USA. For instance, the ACE Acceleration Programme (2013-2015) that delivered new value-added support to high potential ICT startups and SMEs to accelerate their international growth by networking leading incubators, accelerators, clusters and living labs throughout Europe, who committed to pooling their knowledge and expertise in internationalization and opening up their existing facilities and support services to each other's local companies, was considered outside the scope of this study as accelerators were only one of many support systems involved. http://europeanace.eu (last consulted on 5 July 2016).

[25] Programs under the European Institute of Innovation and Technology (EIT) are discussed in more detail in the Climate KIC Accelerator case study further on.

Table 1: European Union's funding of accelerator activity

RECIPIENTS	EXAMPLES OF FUNDED INITIATIVES
NETWORKING ACTIVITIES	ATALANTA PROJECT - EUROPEAN ACCELERATOR SUMMIT ACCELERATOR ASSEMBLY
PROGRAMMES	EU-XCEL - EUROPEAN VIRTUAL ACCELERATOR IOT ACCELERATOR STARTUP SCALEUP PROGRAMME COPERNICUS ACCELERATOR PROGRAMME
STARTUPS/SMEs	FIWARE - EUROPEANPIONEERS SME INSTRUMENT

Networking activities

The ATALANTA project and the European Accelerator Summit

The ATALANTA project[26] supports groups of leading accelerators for delivering cross border services to innovative SMEs and entrepreneurs and links these groups with knowledge creators and education organizations (e.g. mentors, trainers, service providers, and partners) on one side and to investors (e.g. venture capital organizations) and the business world (e.g. potential clients, partners, suppliers, and venture capitalists) on the other side. Via the ATALANTA project the European Accelerator Summit[27] is organized. In 2013, five accelerators (Beta-i, H-Farm, Silicon Sentier, Tetuan Valley, and Balkan Unlimited) from five different European countries came together, to share best practices and exchange experiences in an industry that was just being born. At different stages of development and operating in ecosystems with different challenges, these five accelerators were themselves able to accelerate through collaboration with each other. During the European Accelerator Summit 2016, leading accelerators from across Europe discussed and debated the current status and future of acceleration through collaborative workshops and interactive talks. The purpose of this one-day conference was to identify the major trends and challenges facing the accelerator sector as well as ideas and viable models to reinforce the future of accelerators.

Accelerator Assembly

As part of the Startup Europe Initiative, the European Commission started an initiative[28] to support and promote web-friendly accelerators in Europe, with the aim of stimulating the growth of web startups and enabling them to become successful, sustainable businesses that will contribute to economic growth and to the creation of employment. Because, despite the

[26] Community Research and Development Information Service Agreement number 611878 (2013-2016), http://cordis.europa.eu/project/rcn/189039_en.html (last consulted on 20 July 2016)
[27] http://www.europeanacceleratorsummit.com/ (last consulted on 14 July 2016)
[28] https://ec.europa.eu/digital-single-market/node/66623 (last consulted on 5 July 2016)

rapid growth of the digital economy in Europe, many tech entrepreneurs still lack access to adequate resources and support to launch their startup. Three of Europe's leading web-friendly support programs – Seedcamp, Startup Weekend and Bethnal Green Ventures – have formed a consortium with Seed-DB, the seed accelerator database, in response to this opportunity, with the aim of delivering an industry-led forum with maximum pan-European reach and impact.

The key aims are: (i) to increase awareness of the existing accelerator programs in Europe and their benefits among web entrepreneurs; (ii) to attract other accelerators to support web businesses to grow the overall number of web-friendly accelerators in Europe; (iii) to foster valuable linkages within the accelerator community in Europe; (iv) to stimulate a policy dialogue to inform both policy makers and practitioners; (v) to improve the evidence base and provide insights and knowledge on accelerators and web startups in Europe; (vi) to increase understanding on how to participate in future EU policy to improve the environment for web entrepreneurship. The initiative is called the Accelerators Assembly[29] and brings the accelerator community together through the organization of events and workshops. Its activities include the creation of an online community to share learning and best practices, as well as to gather research evidence to improve the knowledge on accelerators and web startups in Europe. The Accelerator Assembly is delivered by Welcome[30] and BISITE Accelerator, with the support of Nesta, How to Web, Techstars London, UPGlobal, Betahaus, Wayra UK, Basekit, Microsoft, dpixel.

Accelerator programs

EU-XCEL – European Virtual Accelerator

The EU-XCEL – European Virtual Accelerator[31] is a network initiative of Startup Europe[32] which supports aspiring young tech entrepreneurs interested in co-founding new international information, communication and technology (ICT) startups through a new startup scrum training and mentored virtual accelerator initiative. This initiative seeks to identify and

[29] http://www.acceleratorassembly.eu/ (last consulted on 29 June 2016)

[30] WELCOME is one of the connectors projects of Startup Europe. WELCOME is aimed at breaking down the barriers between 5 different major EU startup ecosystems (Berlin, Dublin, Milan, Madrid and Salamanca) by teaming up with local partners present in these ecosystems to identify and engage the most relevant players of the tech entrepreneurial world (e.g. investors, mentors, media, corporates, successful entrepreneurs, etc.) and connect them with prospective, emerging and successful tech startups. In addition, WELCOME also aims to bridge the divide between the tech entrepreneurial world and policy makers. In Berlin, the organisations that ensure this connection are: The Factory, etventure and Betahaus. http://startupeuropeclub.eu/connectors/; http://startupeuropeclub.eu/berlin/ (last consulted on 18 July 2016)

[31] http://euxcel.eu/ (last consulted on 18 July 2016)

[32] EU-XCEL received funding from the EU's Horizon 2020 Research and Innovation Programme under Grant Agreement number 644801.

empower aspiring young tech entrepreneurs to become 'incubator ready' with real products of promise in the areas of the internet of things, health informatics, big data, ICT4development, predictive analytics, and E-/M- Commerce. The action plan consists of: (i) deliver a week-long intensive entrepreneurial training named "Startup Scrum" across the six European countries of Ireland, Denmark, Germany, Greece, Poland, and Spain; (ii) provide online mentoring and technical supports to EU-XCEL teams to develop their startup ideas through a European Virtual Accelerator; (iii) select the best startup scrum teams to compete in an EU-XCEL Ultimate Challenge Final where they will pitch to leading venture capitalists, angel investors, and successful entrepreneurs.

The IoT Accelerator Startup Scaleup program

Startup Europe's IoT Accelererator Startup Scaleup [33] received funding from the EU's Horizon 2020 research and innovation program[34]. Startup Scaleup is a pan-European IoT Accelerator that provides a broad range and quality of services to ambitious entrepreneurs who want to launch and grow companies focused on the Internet of Things (IoT). The aim is to build a European ecosystem around four consolidated ecosystems in Spain (Cartagena), the Netherlands (Zoetermeer), Lithuania (Vilnius), and Ireland (Dublin) together with F6S[35] – a social network for startups in the EU that also comprises a data-driven tool for accelerators to let startups apply (first stage of selection process).

These four ecosystems, who have a track record and complementary strengths, are supporting startups by enhancing the basic business skills of entrepreneurs as well as increasing technological advancement to accelerate the accepted startups. Startup Scaleup[36] is run by Universidad Politécnica de Cartagena, Crosspring Lab, Open Coffee Club Lithuania, the Ryan Academy, F6S and BluSpecs[37].

Startup Scaleup is a six-month accelerator program, enabling accepted startups to receive support and mentorship from IoT people. Startup Scaleup is a no-strings attached program: no equity, no cost. Participants will get to work with other IoT startups, startup incubator hubs in Ireland, Spain, the Netherlands, and Lithuania and are supported by mentors working on design, prototyping, manufacturing, licensing and fundraising for their products. The journey begins with the IoT'ers week in all four hubs and consists of an intense schedule

[33] http://startup-scaleup.eu/ (last consulted on 6 July 2016)
[34] Under Grant Agreement number 644023.
[35] https://www.f6s.com/ (last consulted on 6 July 2016)
[36] Scaleup is a connectors project of Startup Europe, next to DIGISTART, ePlus, TWIST and WELCOME. http://startupeuropeclub.eu/connectors/ (last consulted on 6 July 2016)
[37] Consultancy firm - http://bluspecs.com/ (last consulted on 7 July 2016)

of activities, lectures, and workshops that cover all the basics for scaling their business and expanding to international markets. Monthly events allow them to make sure they reached KPIs and give them a chance to meet other teams developing their product. The program ends at each hub with a local pitching event and the best teams get to participate at one of the largest European IoT conferences – Connected conference[38] in Paris.

For the first batch, ran in 2015, they received 179 applications, 49 teams were selected from 11 countries, raising €3,035,500. The selection process for the second batch ran from April to May in 2016 and received about 370 applications. The greatest number of applicants is in the prototype stage (143), some have customers (94), others have developed products (86), and, very few (3) have a large-scale production. On average, the startups that have applied to this acceleration program are founded by between 2 and 4 people. From the applications received the average revenue generated by most of those startups (85) so far amounts to €1,000, while about 40 have already raised between €1,000 and €50,000. In June 2016, the 84 accepted applicants started the program with 20 in both Cartagena and Vilnius and 22 in both Dublin and Zoetermeer. The IoT verticals are in various sectors including home (18), health and medical (15), wearables (11), transportation (9), retail (5), agriculture (5), clean tech (4), logistics (1) and others (16).

The Copernicus Accelerator Programme

EU support is not limited to web-related accelerator programs to generate economic growth. The Copernicus Accelerator Programme[39] aims to speed up the user uptake of the EU's Earth observation program Copernicus as it fosters the development of commercial space applications and products. Tremendous amounts of data from space - especially the kind produced by Copernicus - present countless opportunities, and are becoming an increasingly common component of commercial products and applications in numerous sectors of the economy. Fascinated by the possibilities in intelligent data analysis, young startups and scientists in particular are developing a growing interest in Earth observation and the big data it generates from space. The Accelerator Programme is an initiative funded by the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROWTH) of the European Commission.[40]

[38] http://connectedconference.co/ (last consulted on 7 July 2016)
[39] http://www.copernicus-masters.com/ (last consulted 7 July 2016)
[40] The DG GROWTH is responsible for: completing the Internal Market for goods and services; helping turn the EU into a smart, sustainable, and inclusive economy by implementing the industrial and sectorial policies of the Europe 2020 initiative. Next to actions towards SMEs, brought together in the Small Business Act, and towards IPR rights, it implements the EU's space policy via its two large-scale satellite programs Copernicus (for Earth

In July 2016, individuals and teams from startups, SMEs, industrial companies, research institutes, and universities were invited to apply online for the Copernicus Accelerator Programme while submitting their business ideas to the Copernicus Masters[41]. The 40 best entrants in the competition, which must be either citizens of one of the Copernicus participating countries (all the EU Member States, in addition to Norway and Iceland) or have established their company in the territory of one of the participating countries, were then selected for the program by an international panel of experts. Through the Copernicus Accelerator, participants receive tailored support from experienced mentors and work with them on advancing their innovations over a period of several months. They are able to determine the focus of this coaching, such as creating a business plan, acquiring their first customers, raising capital, etc. Scheduled to last six to eight months, the Copernicus Accelerator kicked off with a boot camp[42] in Madrid in October 2016 bringing 40 pioneering entrepreneurs, 31 mentors and representatives of the European Commission and the European Space Agency together. In search of synergies, this event created momentum for mentees to meet their mentors and connect with industry leaders, renowned institutions and startups. This event forms part of the Satellite Masters conference and the Awards Ceremony of the Copernicus Masters competition[43].

Accelerator programs as intermediaries for SME funding

FIWARE and EuropeanPioneers

The European Commission[44] has some funding opportunities and has helped create networks within the European technology ecosystem to promote growth and share best practice. There was almost €850 million available for ecosystems builders as well as funding opportunities to

observation) and Galileo (for global navigation), as well as research actions designed to spur technological innovation and economic growth. http://ec.europa.eu/growth/about-us/, http://www.copernicus-masters.com/index.php?kat=copacc.html&anzeige=copacc-mentors.html. (last consulted on 24 November 2016)

[41] An international competition in the commercial use of Earth observation data. This competition is on the hunt for outstanding ideas, applications, and business concepts that use such information in everyday life. Along with cash prizes, the winners will receive access to a leading international network, corresponding data, startups funding, and other support. Over the past five years, the Copernicus Masters has already selected a total of 40 winners from among more than 700 cutting-edge business ideas from 60 different countries. www.copernicus-masters.com (last consulted 24 November 2016).

[42] http://www.space-of-innovation.com/first-copernicus-accelerator-bootcamp/ (last consulted on 24 November 2016)

[43] The team around Grega Milcinski from Slovenia's Sinergise Ltd., whose *Sentinel Hub* - a cloud-based web service for satellite data - won the 2016 Copernicus Masters competition. http://www.space-of-innovation.com/smart-data-access-pathbreaking-web-service-sentinel-hub-wins-2016-copernicus-masters-competition (last consulted on 24 November 2016)

[44] https://ec.europa.eu/digital-single-market/en/capital (last consulted on 5 July 2016)

startups and SMEs. Via its FIWARE Accelerator Programme[45], worth of €80 million (in 2014-2015), the European Commission launched a massive call for web entrepreneurs, SMEs, and startups owning an innovation idea able to penetrate the market and be the basis of a sustainable business. The call targeted seed-type activities that generate actual take-up of innovative internet services and applications. As of September 2014, the 16 selected FIWARE accelerator projects[46] published open calls for the distribution of grants to SMEs and web entrepreneurs. The predefined industrial sectors for these accelerator projects were: smart cities, ehealth, transport, energy and environment, agrifood, media and content, manufacturing and logistics, and social and learning.

The FIWARE Community is presented as an independent open community whose members are committed to materialize the FIWARE mission: to build an open sustainable ecosystem around public, royalty-free and implementation-driven software platform standards that will ease the development of new smart applications in multiple sectors. This community was not only formed by contributors to the technology – the FIWARE platform[47] – but also by those who contribute in building the FIWARE ecosystem and making it sustainable over time. As such, individuals and organizations committing relevant resources in FIWARE Lab[48] activities or activities of the FIWARE Accelerator, FIWARE Mundus[49] or FIWARE iHubs[50] programs are also considered as members of the FIWARE Community. "Think globally act locally" is a distinguishing mark of the FIWARE ecosystem.

[45] Source: https://ec.europa.eu/digital-single-market/en/fiware-accelerator-programme (last consulted on 5 July 2016)

[46] https://www.fiware.org/accelerators (last consulted on 5 July 2016)

[47] The FIWARE platform provides a set of application programming interfaces that ease the development of smart applications in multiple vertical sectors. The specifications of these interfaces are public and royalty-free. An open source reference implementation of each of the FIWARE components is publicly available so that multiple FIWARE providers can emerge faster in the market with a low-cost proposition. https://www.fiware.org/accelerators (last consulted on 5 July 2016)

[48] The FIWARE Lab is a non-commercial sandbox environment where innovation and experimentation based on FIWARE technologies take place. Entrepreneurs and individuals can test the technology as well as their applications on FIWARE Lab, exploiting open data published by cities and other organisations. FIWARE Lab is deployed over a geographically distributed network of federated nodes leveraging on a wide range of experimental infrastructures. https://www.fiware.org/accelerators (last consulted on 5 July 2016)

[49] Although it was born in Europe, FIWARE has been designed with a global ambition, so that benefits can spread to other regions. The FIWARE Mundus program is designed to bring coverage to this effort engaging local ICT players and domain stakeholders, and eventually liaising with local governments in different parts of the world, including North America, Latin America, Africa and Asia. https://www.fiware.org/accelerators (last consulted on 5 July 2016)

[50] The network of FIWARE iHubs will play a fundamental role in building the community of adopters as well as contributors at local level. The FIWARE iHubs program aims at supporting the creation and the operations of iHubs nodes worldwide. https://www.fiware.org/accelerators (last consulted on 5 July 2016)

EuropeanPioneers[51] was one of the above mentioned 16 programs across Europe fostering innovative businesses on the basis of breakthrough FIWARE Future Internet technologies. EuropeanPioneers received funding[52] from the EU's Seventh Framework Programme for research, technological development and demonstration as part of the EU's Future Internet Public Private Partnership Programme (FI-PPP). EuropeanPioneers distributed funding provided by the EU. It was public money, so beneficiairies did not have to give away equity in their business in order to benefit. Total grants ranged from €50,000 to €250,000 per project (depending on the business model, current status and financial needs). Participants were supported in developing cutting-edge business skills via face-to-face workshops, online webinars, mentoring activities, and a shared project management platform. Review workshops were conducted to discuss and analyse progress on both technical and financial levels. Selected teams were supported in building minimum viable products assessed through systematic user tests with a total of at least thousand users across Europe.

EuropeanPioneers was the Berlin-based accelerator eight-month program that develops the participants' wide-ranging business skills through coaching and mentoring activities. Benefits also arose from the strong network of business experts and other startups involved in the FI-PPP. The accelerator was led by Berlin-based startup builder etventure in partnership with technology expert partner Fraunhofer IAIS (Germany), ThoughtBox (Ireland), Weblify (Poland) and F-Secure (Finland). This accelerator program aimed to boost the development of digital SMEs and webentrepreneurs in the media and content sector in Europe. Participants were connected with the platform and technologies of FIWARE – cutting-edge applications developed at the European level to enable fast and effective web developments. A co-working space was not provided. Participants became part of the team – remotely and had to be prepared to travel to Berlin several times. The infrastructure was provided to guarantee effective communication and exchange of best practices throughout the program. Participants who needed support were visited.

In the final round in 2015, EuropeanPioneers[53] funded 13 startups chosen out of 660 applications from a European wide selection process. Each of the chosen teams received €175,000 in funding without giving up equity. 13 startups from the European tech hubs in Berlin, Barcelona, London, Copenhagen and Tel Aviv started the second rond of this EU

[51] http://www.europeanpioneers.eu/en/ (last consulted on 7 July 2016)
[52] Under the Grant Agreement number 632871.
[53] Press release 13 august 2015, http://www.etventure.de/wp-content/uploads/2015/08/20150813_EuropeanPioneers-Accelerator_Start-2nd-Batch.pdf, last consulted on 7 July 2016)

accelerator program in August 2015 in Berlin. During the "welcome days" the startups were introduced to lean startup and design thinking methodologies. The "training weeks" were held in Tel Aviv, London and Berlin. The startups of this round were focused on the business areas of smart city, media and content, and social and learning.[54]

THE EUROPEAN UNION AND SME FUNDING

In addition to financing SMEs with European funding via their programs as an intermediary, accelerators may provide participants with information on the availability and procedures on how to access direct funding for SMEs provided by the European Union (EU), like for instance via the SME Instrument[55]. At least 20%, nearly €9 billion, from Horizon 2020's 'leadership in industrial technologies' and 'societal change' pillars is expected to benefit SMEs directly in the form of grants, including the funding via the SME Instrument. SMEs from EU Member States or countries associated to Horizon 2020 can apply. With a budget of €77 billion over seven years, Horizon 2020 is the largest EU research and innovation program and envisages record funding for SMEs. The latest round brings the total number of companies funded by the SME instrument so far to 2,116, with more than €694.8 million in EU grants. Through the SME Instrument, the EU wants to finance the most innovative small companies with a high-growth potential to get ideas from the lab to the market and help generate growth and jobs in Europe. The Instrument is worth around €3 billion over seven years and offers fast and simple grants for business innovation feasibility studies (Phase 1) and demonstration projects (Phase 2). Investment-mature concepts can, in addition, benefit from business development advice and other support services (Phase 3).

In July 2016, it was announced that the European Commission will invest €86 million, in 236 innovative SMEs from 31 countries. Out of the €86 million, €77.7 million will be given to 58 highly innovative SMEs from 16 countries under Phase 2 of the scheme – in which SMEs will further develop their submitted proposal in Phase 1 of the scheme through innovation activities. Each project, 48 in total, will receive between €0.5 and €2.5 million (€5 million for health projects) to bring their product from pilot-phase to the market. They can also ask for up to 12 days of free business coaching. 961 proposals were received under Phase 2 by the cut-off date of 14 April 2016. UK companies have been particularly successful in this call with 13

[54] Although EuropeanPioneers Accelerator is no long active, they appear to still support another new accelerator program based in London, named MarathonArtist Labs

[55] https://ec.europa.eu/easme/en/news/sme-instrument-european-commission-invest-86-million-236-innovative-businesses (last consulted on 8 July 2016)

projects. They are closely followed by Spain (11), and Italy (9). Most of the projects funded will be in the area of ICT (9) and transport (9) followed by low-carbon energy systems (8). Since the launch of the program on 1 January 2014, 373 projects involving 464 SMEs have been selected for EU grants under Phase 2 of the SME Instrument, totaling more than €619.5 million.

Another 166 projects involving 178 SMEs from 28 countries have been selected in the latest round of under Phase 1 of the SME Instrument. Each project will receive €50,000 to finance feasibility studies for new products that can disrupt the market. They can also request up to three days of free business coaching. The SMEs will receive €8.3 million in total for this cut-off. 1975 proposals were received under Phase 1 for the 3 May 2016 cut-off. Spain ranks first, with 32 projects selected for funding, followed by Britain (23) and Italy (22). Most projects will be funded in the area of ICT (30) followed by transport (22) and low-carbon energy systems (22). Since the launch of the program on 1 January 2014, 1652 SMEs have been selected under Phase 1 of the SME Instrument and shared almost €75.3 million. The next cut-off is 7 September 2016 for Phase 1 and 13 October 2016 for Phase 2.

THE CLIMATE-KIC ACCELERATOR: a case study

The EU funded Climate-KIC program is discussed in detail below as an illustrative case study of a policy instrument. This program has been studied in depth through desktop research and semi-structured interviews with the program managers and participating startups. Although this is a European-wide activity, the Climate-KIC UK is of particular interest as it emulated the philosophy of a traditional accelerator in their mission to support entrepreneurial ventures. As the entrepreneurship lead acknowledges, "*it is pretty harmonized across Europe, there is a basic programme but then we have local differences. For example, the final stage is a bit harder to achieve in the UK.*"

Climate-KIC Accelerator (United Kingdom & Ireland)[56]

Climate-KIC is one of five Knowledge and Innovation Communities (KICs) set up by the European Institute of Innovation and Technology (EIT)[57], an EU body assigned with creating sustainable European growth while dealing with climate change, one of the major global challenges of our time. This particular KIC is Europe's largest public-private innovation partnership that comprises of support schemes for students, businesses, and entrepreneurs.

[56] http://www.climate-kic.org/national-centres/london-uk/ (last consulted 1 November 2016)
[57] See explanation on EU programs in the beginning of the essay.

When looking at its portfolio of support activities for entrepreneurs, it comprises four main elements: (1) business plan competitions, such as the ClimateLaunchpad which is Europe's largest cleantech business plan competition; (2) education-intensive workshops; (3) placement programs for professionals to work on innovative projects; and (4) the Climate-KIC (pre-) Accelerator, acknowledged as the number one cleantech accelerator worldwide.

The Climate-KIC accelerator in the United Kingdom is a university technology accelerator (see Byrd, Herskowitz, Aloise, Nye, Rao & Reuther, 2017). Inspired by the model of Y Combinator and embedded in a university surrounding, it pushed ventures to validate a product-market combination and pivot (if deemed appropriate) based on intense customer discovery. It is designed with the clear goal to prove the feasibility and transform cleantech ideas into investable business cases. The focus on business development combined with mentoring and networking, alongside a supportive peer-to-peer environment and pre-seed investment grants, sets it apart from existing incubator models (Isabelle, 2013).

Overall, the program followed a stage gate process linked with a grant funding mechanism open to academic researchers, students and external entrepreneurs. It is designed to fit the particular needs of high-technology ventures. Design highlights are for instance:

- Stage gate approach with open (learning) milestones in order to better suit the pace of each startup. Up to €95,000 'grant' funding is awarded over three stages: (1) Stage I to draft the initial business model and customer discovery plan (~€20,000); (2) Stage II to validate the business model by "getting out of the building" and gathering customer feedback (~€25,000); and (3) Stage III to gain market traction i.e. customer-and investor wise (~€50,000). It is a way for the program to commit entrepreneurs towards the achievement of learning goals such as proving that the venture had "*locked-in on the market*".
- Implementation of an experimental learning approach i.e. the lean startup method. The program's intended (learning) outcome was described by the accelerator management as an approach "*to ensure that teams who complete the program have a clear focus on the specific markets and value propositions that will enable them to raise meaningful external investment*".
- Co-location of the ventures in university-centered ecosystems with access to its advanced technical facilities and technology support vouchers.
- Pre-incubation support to help budding entrepreneurs develop climate innovative ideas combined with a sustainable business model. Each project will have a coach assigned with a fixed number of coaching hours, up to €5,000 funding and additional project support. It provides an informal and flexible environment to assess the market potential of a business

idea, develop a business model and find out whether entrepreneurship is the future career prospective for the participant

- Tailored coaching by core team, support from expert commercial advisors and an Entrepreneur-in-Residence (EIR) following the participants from day one. EIRs are selected based on their entrepreneurial track record and their expertise in the complex and heavily-regulated cleantech industry.

Since its launch in 2010, it runs activities in multiple locations across Europe (France, Germany, The Netherlands, Denmark, United Kingdom and Switzerland) and supports over 120 startups in Europe each year. Within the UK only, this unique program has so far supported 45 European cleantech startups to collectively raise €59 million in external investment, a median of €1.15m per startup (last updated figures end of 2015). For instance, one of the 45 startups, UK-based Aqdot has developed an intelligent encapsulation platform technology and know-how which enables valuable active products to be protected, delivered and chemically programmed to release where and when required. Aqdot has now raised around €8.5m in VC funding[58].

To summarize, the Climate KIC accelerator supports new ventures at key points of the commercialization journey using an ecosystem approach. This approach co-locates participants in university-centered ecosystems with a focus on the community-aspect, grants them access to advanced technical facilities and technology support vouchers. These are considered key elements in order to be able to deliver a responsive and connected support program. For instance, the technology support vouchers of up to €50,000 enables startups to leverage the ecosystem by accessing critical expertise and know-how.

To be eligible, a technological proof-of-concept is required that has climate impact and scalability. Three open calls are publicized each year and application is by submission of a four-page document including details of the market problem and opportunity, product or service, innovation, business model, climate impact, team, roles and commitment, development status and references. The application undergoes a multi-stage selection procedure comprising of a desk assessment, review by an expert panel and an interview with the accelerator management team. Of the startups entering through the 2015 calls, Climate-KIC received 62 applications of which 10 were selected on to the program.

Importantly, in order to secure the future support of early-stage ventures, accepted applicants are from 2016 onward required to go through Stage I and II in a maximum of 12

[58] Crunchbase and Climate-KIC London Salesforce database (last consulted 15 March 2016)

months in order to transition to the Stage III. This case study on the Climate-KIC highlights the role of the EU in entrepreneurial ecosystems and how this role is evolving over time. Originally, and in line with EU policy, the Climate-KIC accelerator program was primarily funded by the EU. This seems to be under evolution as current Climate-KIC programs are in active search for funding from private partners to reinforce, complement and eventually take over the funding role of the EU. A shift is initiated from EU funding towards funding from private partners as the Climate-KIC program has long outgrown its infancy stage and has evolved into maturity now dealing with the challenge of self-sustainability. As such, the role of the EU is evolving from safeguarding the setup of the initiative and, once proven viability, to transfer it to the private sector to safeguard its longevity.

CONCLUSIVE THOUGHTS

EU policy is often positioned as reactive and an attempt to emulate US policy. Looking at the examples of US and EU policy on accelerators, similarities and differences become apparent. Clearly, policies on both sides of the Atlantic are aimed and increasing entrepreneurial activity and economic growth, with both aiming to increase awareness and providing funding to where there are gaps in the entrepreneurial ecosystem.

The aim of the US policy to support accelerator activity is to fill geographical gaps in the accelerator and ecosystem scene, as in some parts of the country there are fewer conventional sources of access to capital, such as VCs and other types of capital. So, location is a distinguishing factor. Besides, in the US policy more attention seems to go to underserved groups, such as women, Native-Americans, and veterans.

The EU policy towards accelerators differs from the US policy as it responds to differing needs. The EU accelerator policy is not merely a reaction to US policy as it is part of a broader macro-economic plan – the European Commission's Entrepreneurship 2020 Action Plan – to answer to challenges brought by the gravest economic crisis in the last 50 years. EU funding of accelerator programs seems to be more focused on particular technological sectors, such as ICT, IoT, and commercial space applications and products, as these are supposed to hold great potential to economic growth and leverage Europe's economy out of its economic crisis. This objective can only be reached with policymakers taking a long-term budget view and continued financial support for a number of years in supporting accelerators in creating flourishing entrepreneurial ecosystems.

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ESSAY 2 – USE OF THE "ECOSYSTEM MODEL" BY ACCELERATORS AT COUNTRY AND REGIONAL LEVELS

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ABSTRACT

Perceived as alternative funding vehicles, business creation tools, and instruments to tackle digital disruption in the corporate world, accelerators play a unique role in entrepreneurial ecosystems as they disperse geographically throughout Europe. The purpose of this study is to improve our understanding of the continuous evolving accelerator landscape and concomitant activities by complementary actors within an ecosystem community. We emphasize the role of institutional intermediaries to shape the ecosystem through the preservation of the aligned interests between policy makers and practitioners. By reviewing the policy support mechanisms for accelerators across national and regional levels and the current trends, we outline the challenges accelerators face and which policy makers need to take into account. We conclude with policy implications and recommendations focusing on how the ecosystem community can meet such challenges in order to spur ecosystem development and fuel the next generation of startups.

Key words: institutional intermediaries, accelerator, entrepreneurial ecosystem, policy implications

INTRODUCTION

It should come as no surprise that context is important when considering entrepreneurship (Autio, Kenney, Mustar, Siegel & Wright, 2014) as it tends to take place within a network of public and private partners that nurture and sustain entrepreneurs. Prior research provide evidence that entrepreneurial ecosystems are increasingly vital to the success of national entrepreneurship initiatives (Drexler et al., 2014) as it offers highly collaborative ways to solve challenges by bringing together within the ecosystem community the potential to build, solve, share and exchange around goals. An ecosystem community consist of human, financial and professional resources that an entrepreneur requires, and an institutional environment in which government encourage and safeguard entrepreneurs (Isenberg, 2010). In other words, high-potential ventures are coproduced through a myriad of usually uncoordinated interactions between different stakeholders, all stimulating innovation by entrepreneurial firms. Examples of such stakeholders are initiatives such as startup support programs (e.g. incubation models like accelerators) focused on helping early-stage ventures. These are of particular interest as it is considered a strong instrument for promoting innovation and entrepreneurship (Aernoudt, 2004; Lamine, Mian, Fayolle, Wright, Klofsten & Etzkowitz, 2016).

Young or new ventures increasingly choose to join business assistance programs as entrepreneurs are facing high levels of uncertainty during their search for solutions to problems that are still imperfectly defined. As these programs have become very heterogeneous (cf. Barbero, Casillas, Wright & Garcia, 2014), startups have a range of business assistance programs to choose from. However, as shown by their rapid growth in recent years, one kind of model seems to stands out as the preferred option for entrepreneurs to kick-start their ventures and decrease market/technology uncertainties, the business accelerator. Such startup support programs are defined as a new generation of incubation models (Pauwels, Clarysse, Wright & Van Hove, 2015) that beyond the conventional incubator offering consisting of basic office space and financial support provide knowledge intensive services essential for startups in their early growth phase.

Contemporary research revealed beneficial effects of accelerator programs on participating startups and the overall ecosystem (e.g. Gonzalez-Uribe & Leatherbee, 2017; Spigel, 2015; Hallen, Bingham & Cohen, 2014; Goswami, Mitchell & Bhagavatula, 2017). These effects are related to accelerating mechanisms such as entrepreneurial schooling, magnification of quality signals to potential investors, access to networking and mentorship. The latter mechanism i.e. mentoring by and networking with (former) entrepreneurs and investors, potential corporate clients that contribute their knowledge, time and connections to

the startup, are key to the accelerator concept (Cohen, 2013). As entrepreneurial ecosystems drive social and economic development by enabling access to markets, human capital and funding for startups, accelerators need to operate in an ecosystem in order to be effective over the course of new ventures' entrepreneurial trajectories. Furthermore, accelerators are crucial in building supportive commercial infrastructure and there is growing interest from policy and corporates to utilize such programs as catalysts in entrepreneurial ecosystems (e.g. Sivonen, Borella, Thomas & Sharapov 2015).

For entrepreneurship policies to nurture and facilitate entrepreneurial ecosystems effectively, policy makers must become more aware of how the different elements of these ecosystems interact (Acs, Szerb & Autio, 2016b). Moreover, to do this successfully, the relative strengths and weaknesses of the multiple factors making up the entrepreneurial ecosystem need to be understood (cf. Acs, Audretsch, Lehmann & Licht, 2016a). Considering the surge in business accelerators, we aim to understand its importance, activities, interactions and the benefits of such programs as part of an entrepreneurial ecosystem. The resulting insights can advise policy on business creation and entrepreneurial initiatives. This study revolves around the concept of a "connected ecosystem" and the blend of various startup support initiatives to advance our understanding of entrepreneurship and policy. It speaks primarily to new forms of incubation models supporting entrepreneurial ventures. Given the exploratory nature of our qualitative study, in-depth interviews combined with publicly available information were used to understand how accelerators evolved over time. The research was conducted in cities with thriving entrepreneurial ecosystems and prominent accelerator activity.

The paper unfolds as follows. First, we provide a brief background on entrepreneurial ecosystems. This is followed up with a discussion of the country- and regional-level policies using the case of United Kingdom (UK) to illustrate the most relevant policies stimulating the development of an entrepreneurial ecosystem. We identified these policy instruments by screening the web using a set of key words related to acceleration, policy and United Kingdom. In the last section, we outline policy implications and our recommendations.

BACKGROUND ON ENTREPRENEURIAL ECOSYSTEMS

Entrepreneurial ecosystems are typically viewed from a national and regional level as the idiosyncratic nature of regional economies and their entrepreneurial ecosystems makes a uniform approach irrelevant. Policies that have been successful in one European country cannot feasibly be adopted successfully in other European countries (Mustar & Wright, 2010; Audretsch & Peña-Legazkue, 2012; Acs & Szerb, 2007). National differences built upon

different evolutionary trajectories or path dependencies may be deep-rooted and difficult to alter. Industrialized countries, like the UK, Germany, France and Italy, have large pools of developed manpower, higher incomes, developed basic infrastructure and large national markets, which provide them with enabling environments to establish science and technology oriented entrepreneurial regions. Mian (2011) shows an emerging history and considerable level of policy and program activity in these large developed nations. In all of these cases any renewed policy efforts were primarily triggered by national concerns about attaining and/or sustaining global competitive advantage through high value added innovation and entrepreneurial activity. In the post 1980s scenario, most of the efforts have been directed towards more decentralized and grassroots-level science and technology transfer and diffusion programs. Another common element is the type of organizational mechanisms developed to address the perceived market or system failures, which predominantly included umbrella organizations, science and technology parks, business incubation models and firm clusters. The efforts to improve talent, technology, capital and entrepreneurial infrastructure issues clearly play a dominant role in the development of policies and their implementation programs (Mian, 2011).

Since accelerator programs came ashore in the United Kingdom (UK) resulting in the creation of the first accelerator programs in Europe and the strongest European accelerator ecosystem, a closer look will be taken on how the government in the UK supports accelerator programs as an example of national government involvement.

METHODOLOGY

Since accelerator programs came ashore in the UK, resulting in the setup of the first accelerator programs in Europe and the strongest European accelerator ecosystem, a closer look will be taken at how the government in the UK supports accelerator programs, as an example of national government involvement.

FINDINGS: COUNTRY-LEVEL POLICIES

Government policy at the national level – the United Kingdom

We focused only on the most relevant instruments of national government policy toward accelerators and actors within the accelerator ecosystems such as government-backed accelerators, the visa policy for foreign startups, tax relief schemes and government-backed venture capital schemes.

Government-backed accelerators primarily aim to stimulate local economic development or achieve social and/or environmental impact (Walters, Stacey, Haley & Roberts, 2014). For instance, one of the UK's most recent government-backed accelerator program HutZero[59] (launched June 2016) is aimed at cybersecurity innovation. Since cybersecurity is of national importance the national government's involvement is not counterintuitive. The idea is to reduce cyber threats in the country while also developing the UK's position in security innovation by encouraging entrepreneurs, students and others starting out in business to develop solutions to fight cybercrime. The initiative is directly funded by the Department for Culture, Media and Sport (DCMS) as part of the Government's National Cyber Security Programme. HutZero is a free two stage early-stage accelerator program that will help transform early-stage ideas into viable propositions and potential new businesses. Run by Cyber London and the Centre for Secure Information Technologies (CSIT), HutZero will support individuals, not teams, interested in starting their own cyber business, connecting them with a range of likeminded entrepreneurs and domain experts.

At the same time, government-backed support and finance for business such as grants, loans, mentoring and consultancy is offered under particular conditions.[60] Since accelerators recruit startups internationally an additional set of rules need to be complied to and different support programs are offered. The Sirius Programme[61], for instance, is the UK's support program for graduate entrepreneurs from around the world looking to start their venture in the UK. The Sirius Programme is run by a consortium of private companies and charities on a not for profit basis in partnership with the Department for International Trade. The program offers a full support package to enable promising entrepreneurs with new ideas that have real growth potential to maximize their chances of success. Successful applicants are admitted to the program for twelve months and the package of support includes: seed funding – a fixed sum for every venture accepted on the program, training – including full pre-acceleration and acceleration stages, mentoring – from experienced entrepreneurs and investors, office accommodation – at one of twelve locations across the UK relevant to the business selected, visa support – applications will be helped through the UK visa process (see below) and may apply for a visa from a dedicated annual allocation.

[59] http://www.hutzero.co.uk/ (last consulted on 9/9/2016)
[60] https://www.gov.uk/business-finance-support-finderr (last consulted on 21/09/2016)
[61] https://www.gov.uk/government/collections/sirius-programme-for-graduate-entrepreneurs (last consulted on 21/09/2016)

Additional support to recruit startup teams internationally comes from The Department for International Trade. They guide entrepreneurs setting up in the UK[62] and promotes the UK by stressing that it has one of the lowest corporation tax rates in the G20, that a company can register within 48 hours, that the labor force is the second largest in Europe and that the government offers support to startups and entrepreneurs including access to mentoring programs and funding through working with the private sector. More specifically, the Department for International Trade's Global Entrepreneur Programme (GEP)[63] supports overseas entrepreneurs and early-stage technology businesses or startups that want to relocate their business to the UK. The program has so far helped to relocate 340 businesses to the UK, create over 1,000 jobs in the UK economy and raise over £1 billion of private investment for companies. Support is free and includes: help to develop business plans, assistance with relocating to the UK, providing introductions to investors, guidance on how to grow internationally, mentoring from experienced entrepreneurs, and continued help once located in the UK. In return for this support, overseas entrepreneurs are encouraged to set up their headquarters in the UK. In order to be able to do so and to potentially take part in UK based accelerator programs candidates need a visa.

In addition, entrepreneurs, from outside the European Economic Area and Switzerland, who want to set up or run a business in the UK need to apply for a Tier 1 (Entrepreneur) visa[64]. However, access is required to at least £50,000 investments funds from one or more of the following: (i) a UK entrepreneurial seed funding competition endorsed by UK Trade and Investment (UKTI); (ii) a UK government department making funds available for the purpose of setting up or expanding a UK business; (iii) a venture capital firm registered with the Financial Conduct Authority (FCA). Alternatively, an entrepreneur can apply if an investment of £50,000 was made in a UK business. The Department for International Trade has endorsed certain Seed Competitions, some of them are accelerators, which support applications for a Tier 1 (Entrepreneur) visa for entry to the UK[65], such as: TechStars London, Oxygen Accelerator, Collider, Emerge Education Accelerator, StartPlanet NI, next to Seedcamp, Wayra, and Entrepreneur First.

[62] https://www.gov.uk/government/publications/entrepreneurs-setting-up-in-the-uk/entrepreneurs-setting-up-in-the-uk (last consulted on 8/9/2016).
[63] https://www.gov.uk/government/publications/dealmakers-for-the-global-entrepreneur-programme (last consulted on 28/9/2016).
[64] https://www.gov.uk/tier-1-entrepreneur (last consulted on 28/9/2016).
[65] https://www.gov.uk/government/publications/entrepreneurs-setting-up-in-the-uk/entrepreneurs-setting-up-in-the-uk (last consulted on 28/9/2016).

The UK government issued several investment schemes to stimulate investment in enterprises. Investment schemes reside under the non-ministerial department of HM Revenue & Customs. Next to the Collective Investment Schemes Center[66] (CISC) – that deals with all operational issues on behalf of HM Revenue and Customs (HMRC) – several investment schemes exist, such as the Social Investment Tax Relief – for investments in social enterprises, the Venture Capital Trust[67] (VCT) Scheme - to encourage investment in small unquoted enterprises, the Enterprise Investment Scheme[68] (EIS) - designed to help smaller higher-risk unquoted companies to raise finance by offering a range of tax reliefs to investors who purchase new shares in those companies - and the Seed Enterprise Investment Scheme[69] (SEIS) aimed at small, early-stage ventures looking to attract equity finance. Since SEIS targets a similar audience as accelerator programs, confirmed in our own field research, this investment scheme will be discussed in more detail. SEIS is designed to help small, early-stage ventures raise equity finance by offering tax reliefs to individual investors who purchase new shares in those ventures. It complements the existing EIS which offers tax reliefs to investors in higher-risk small companies. The rules mirror those of EIS as it is anticipated that companies will go on to use EIS after an initial investment under SEIS.

Income Tax relief is available to individuals who subscribe for qualifying shares in a company which meets the SEIS requirements, and who have UK tax liability against which to set the relief. Investors do not need to be UK residents. The shares must be held for a period of 3 years, from date of issue, for relief to be retained. Relief is available at 50% of the cost of the shares, on a maximum annual investment of £100,000. The relief is given by way of a reduction of tax liability, providing there is sufficient tax liability against which to set it. A claim to relief can be made up to 5 years after the 31 January following the tax year in which the investment was made.

For its investors to be able to claim and keep the SEIS tax reliefs[70] relating to their shares, the enterprise which issues the shares has to meet a number of requirements. Some of

[66] https://www.gov.uk/guidance/collective-investment-schemes-centre-contacts (last consulted on 16/09/2016)
[67] https://www.gov.uk/hmrc-internal-manuals/venture-capital-schemes-manual/vcm50010 (last consulted on 4/10/2016). Similar to an investment trust, a VCT is an HMRC approved company which subscribes for shares in, or lends money to, small unquoted companies. Under the VCT scheme, VCTs and their investors enjoy certain tax reliefs.
[68] https://www.gov.uk/government/publications/the-enterprise-investment-scheme-introduction/enterprise-investment-scheme (last consulted on 16/09/2016)
[69] https://www.gov.uk/topic/business-tax/investment-schemes; https://www.gov.uk/guidance/seed-enterprise-investment-scheme-background (last consulted on 16/09/2016)
[70] https://www.gov.uk/guidance/seed-enterprise-investment-scheme-how-companies-qualify (last consulted on 19/09/2016).

these apply only at the time the relevant shares are issued. Others must be met continuously, either for the whole of the period from date of issue of the shares, or in some cases, from date of issue of the shares to the third anniversary of their issue. If the enterprise ceases to meet one or more of these conditions, investors may have their tax relief withdrawn. Finally, there are requirements[71] as to how the enterprise must use the funding it has raised via the issue of relevant shares and the enterprise needs to run a qualifying trade which is conducted on a commercial basis with a view to the realization of profit.

The Small Companies Enterprise Centre[72] (SCEC) decides if an enterprise and a share issue qualify, and is responsible for monitoring enterprises to ensure that they continue to meet the requirements of the scheme for the duration of the qualifying period for any share issue. HMRC operate an advance assurance facility for SEIS as it does for the existing EIS. This facility allows enterprises to submit details of their plans to raise money, their structure and their activities in advance of an issue of shares, so that the SCEC can advise on whether or not the proposed share issue is likely to qualify for relief. If the SCEC accepts that the enterprise, its activities, and the shares all meet the requirements of the scheme, it will issue the enterprise with a certificate to that effect, and will supply claim forms for the enterprise to send to the investors so they can claim tax relief. Prior research (Cowling, Bates, Jagger & Murray, 2008) on the impact of VCT and EIS found evidence of an increased rate of accumulation of fixed assets, an increased rate of job creation, and increased sales turnover. Enterprises had lower profit margins and survival rates when compared to matched enterprises. Lower profit margins are to be expected for schemes investing in young, growth-oriented, and often pre-profit firms. Lower survival rates included both voluntary exists and the acquisition of attractive enterprises by larger firms and should, therefore, not necessarily be interpreted negatively (Nightingale et al., 2009).

Research (Nightingale et al., 2009) demonstrates that there is a role for government-backed 'hybrid' venture capital schemes to reach those young businesses that have difficulty accessing funds from purely private investors. These 'hybrid' venture capital funds refer to arrangements where the state invests in a venture capital fund managed by a commercial venture capital fund. Government intervention to address any market failure or under-investment would be warranted. This is particularly the case if funding problems constrain the growth of the very small number of high-growth enterprises that hold the potential of creating

[71] https://www.gov.uk/guidance/seed-enterprise-investment-scheme-investment-and-investor-requirements (last consulted on 19/09/2016)
[72] https://www.gov.uk/guidance/seed-enterprise-investment-scheme-procedures (last consulted on 19/09/2016).

jobs and be drivers of economic growth. By the mid-1990s, a portfolio of policy instruments was introduced like for instance the above mentioned VCT and EIS schemes (Nightingale et al., 2009). In addition, the 1998 Competitiveness White Paper focused on supporting venture capital provision throughout the UK. It announced the formation of a £270 million Enterprise Fund working in partnership with the private sector to address market weaknesses through for instance Regional Enterprise Funds, a UK High Tech Fund of Funds and an Early Growth Fund (Nightingale et al., 2009). Later hybrid funds include the Enterprise Capital Funds (ECFs) developed following a 2003 consultation that pointed out that while funding had improved, a small and significant number of enterprises still faced funding difficulties (Nightingale et al., 2009). One of the organizational innovations with the ECF has been the semi-privatization of its operation. This was done through Capital For Enterprise Ltd, an enterprise originally fully owned by the Department for Business, Innovation and Skills[73]. The enterprise acted as a consultancy and asset management business for the government and managed the loan guarantee schemes as well as hybrid VC programs. The enterprise was a substantial investor in UK VC funds and its close connections to the government, together with its independence, enabled it to stay away from some of the conflicts of interest that plague public sector-run funds while still being responsive to government policy (Nightingale et al., 2009).

Policies at the regional level

The idiosyncratic nature of regional economies and their entrepreneurial ecosystems makes a uniform approach irrelevant. Systems of entrepreneurship are geographically bounded e.g. London, Berlin and Paris serve as an example of cities with thriving entrepreneurial ecosystems and prominent accelerator activity. Those cities are internationally acknowledged as local ecosystems that provide the best support for both startups and scale-ups. The European Digital City Index and the Regional Entrepreneurship and Development Index (REDI), both complex indicators of regional entrepreneurship that capture individual-level actions as well as contextual influences such as the financial possibilities of business, consistently rank the entrepreneurial performance of London, Paris and Berlin among the top in the European Union (Szerb et al., 2013).

[73] On 1 October 2013, Capital For Enterprise Ltd transferred its operations and staff to the British Business Bank Programme. Source: https://www.gov.uk/government/organisations/capital-for-enterprise-ltd; http://british-business-bank.co.uk/ (last consulted on 7/10/2016). The Department for Business, Innovation and Skills (BIS) and the Department of Energy and Climate Change (DECC) have merged to form the Department for Business, Energy and Industrial Strategy (BEIS) in July 2016. Source: https://www.gov.uk/government/organisations/department-for-business-innovation-skills; https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy (last consulted on 19/09/2016).

The strength of each of the capital's position as one the of the strongest and vibrant startup ecosystems in Europe is being underscored by the very existence of an amalgam of acceleration models conceptualized as Ecosystem Builders, Welfare Stimulators and Deal-flow Makers (Pauwels et al., 2015). This is not surprising as the region created the conditions for accelerators to take off. They have a sufficiently dense population of entrepreneurial ventures to be attractive for accelerators and have developed a seed stage funding supply resulting in improved circumstances for startups and startup programs to make an impact (Salido et al., 2013).

The three different types of incubation models identified by Pauwels et al. (2015) demonstrates how accelerator programs adopt different ways of structuring and running their programs depending on the objectives of their key stakeholders. For instance, the Ecosystem Builder tend to be backed or sponsored by large corporates and has a strong focus on (corporate) customers by helping new ventures through the complex corporate decision-making structures. Deal-flow Makers are perceived as high-risk investment funds getting early-stage ventures ready for their follow-up investments. Finally, the Welfare Stimulators are tools typically supported by public institutions with the aim to foster their (entrepreneurial) ecosystems. Based on our research the table below categorizes well-known accelerators representing each of these models based in London.

Table 2. Examples of Incubation Models in London, Paris or Berlin

Incubation Models	Examples of Acceleration Programs
Ecosystem Builders	Fintech Innovation Lab
	Starburst Accelerator
	Grants4Apps Accelerator
Welfare Stimulators	MassChallenge
	NUMA Paris
	Eyefocus Accelerator
Dealflow Makers	Deep Science Ventures
	TheFamily
	Axel Springer Plug & Play Accelerator

All three regions are considered to be well-developed ecosystems, each housing numerous accelerator programs which are active on different levels (local / regional / national / international). However, empirical data indicates that the three startup ecosystem evolution paths (London, Paris and Berlin) exhibit distinct phases, each characterized by distinct challenges and arenas of activity. For instance, London underwent profound changes in the entrepreneurial finance landscape since the launch of the first accelerator in 2008. The focus

was no longer only on venture capitalists and business angels and traditional funds experimented early on with new forms of finance, hereby adopting rather quickly similar accelerator activities as in the USA which seemed to be successful (Miller & Bound, 2011). Afterwards, policy makers and other ecosystem stakeholders followed the accelerator hype. When compared to Berlin and Paris, our fieldwork shows that each region had a different ecosystem stakeholder initiating the launch of the accelerator scene in order to spur ecosystem emergence. Early programs in London were launched primarily by venture capitalists experimenting with new forms of finance and seeking to develop deal-flow. In contrast, the surge in accelerators in Berlin was attributed to large corporates. Furthermore, the arenas of activity differ mostly in terms of specialization. For instance, Fintech is a particular popular sector among London-based accelerators (Bone, Allen & Haley, 2017).

As policy makers should take an ecosystem perspective when considering new actions for further ecosystem development, we reveal in the next section current regional policies and how accelerator activity is linked to other initiatives. We illustrate this with the case of London as it has the highest degree of accelerator activity within a vibrant entrepreneurial ecosystem. Using information-rich cases such as London and a multi-source data collection approach strengthened the accuracy of our findings.

London's accelerator ecosystem

London's clear advantage over the rest of the country (and even the continent) can be explained by the intrinsic relation of London to key financial and advisory institutions. Furthermore, the metropolis is and has been the world center of financial technology for decades due to the presence of the woolly mammoths of finance located in the City and tech hubs nestling in their close proximity, such as Shoreditch. Although the past few years, government has been striving for a national equilibrium (e.g. the national network of Entrepreneurial Spark accelerator centers and the Sirius Programme) the difference in startup support is still prevailing. While its centricity approach has left the rest of the UK mostly under-served the past decade, there is a trend of new programs being launched towards other cities such as Birmingham, Bristol, Cambridge and Manchester (Bone et al., 2017).

Up until the end of 2016, the region housed at least 56 accelerators with 2016 being the most active year since the launch of the first privately funded accelerator Springboard (launched in 2009 and merged with Techstars in 2013) and the first university-based accelerator InnovationRCA in 2008. Moreover, the latest statistics suggest that more than half of the UK's total number of accelerators are based in London (Bone et al., 2017). The surge in

new programs can be partially explained by corporates embracing the accelerator model as a tool for external innovation (Kohler, 2016). This is partially due to the paradigm shift inside large corporates toward open innovation as they recognize the limits of 'closed' internal R&D (West, Salter, Vanhaverbeke & Chesbrough, 2014). In fact, according to Bone et al. (2017) accelerators are now most commonly funded by corporates, including corporate VC units.

Complementary to the national level pro-business environment created through talent recruitment practices, generous tax breaks for seed investors, reduced corporation tax and a regulatory framework that stimulates legal efficiency, the City of London is known for setting up coordinating initiatives which interconnects the different ecosystem stakeholders and facilitates co-opetition amongst them. Interestingly, these initiatives – backed by the Mayor of London and the UK government – also act as an institutional intermediary between policy makers and practitioners in order to preserve alignment of interests of the ecosystem stakeholders. By institutional intermediaries, we mean actors that link two or more parties to bring about activities that could not readily happen otherwise (cf. Dutt et al., 2015; Armanios, Eesley & Eisenhardt, 2016). In the context of an entrepreneurial ecosystem, institutional intermediaries are entities that coordinate and/or influence ecosystem stakeholders by shaping the ecosystem, stimulating multi-party collaboration and adding value through its own capacities, such as to help entrepreneurs obtain public funding.

To illustrate such an institutional intermediary, Capital Enterprise[74] is a leading membership body for London-based universities, accelerators and incubators that support entrepreneurs. Capital Enterprise represents the interests and the views of its members to influential public sector bodies such as the Mayor of London, the former Department for Business, Innovation & Skills etc. It is funded through members' subscriptions, third party sponsorship and by income received from public/private sector partners to develop, pilot and manage innovative programs that support enterprises and entrepreneurs in London. Overall, it provides a support service and platform that identifies and then selects some of the best innovative and scalable startups in London to showcase and connect them to London's leading investors, advisers and accelerator programs. Furthermore, from 2015 onward it complemented its coordination role with the management of an early-stage investment fund, named the London Co-Investment Fund[75]. By developing and running a pipeline of investment-ready tech businesses that will be referred to its selected co-investment partners, this £25M fund aims to

[74] http://capitalenterprise.org (last consulted on 01/11/2016)
[75] http://lcif.co (last consulted on 01/11/2016)

co-invest 150 seed investments of £250K-£1M in the best tech startups by the end of 2015. Established accelerators, such as Techstars, Collider and Startupbootcamp have been able to use this co-funding to massively expand their activities. Furthermore, investment brokerage services, such as Capital List, crowdfunding platform CrowdCube and the London Business Angel Network have been supported by the program e.g. trade missions to Singapore, China and the USA have been co-funded. By the end of 2015 it has supported over 700 businesses and created over 400 new jobs in London. Capital Enterprise is in contact with other regions in the UK and Europe about how they could replicate the program's success in combining public and private money to stimulate the evolution and growth of a startup ecosystem[76].

It is clear that London differs from other entrepreneurial ecosystems due to its outstanding quality and abundance of startup support services. Nonetheless, critics are voicing concerns that an overall systemic policy approach to support startups is still lacking. For instance, the funding gap of between £250K – £500K (which is usually the amount of funding needed by early-stage ventures as they graduate from accelerators) still persists. Microsoft Accelerator, for instance, extends its support by offering a connected ecosystem, called Microsoft Accelerator Alumni Program, so startups can continue to leverage access to resources, networks, and potential customers. Others aim to help bridge this gap between seed funding and the so-called Series A crunch, by designing an accelerator program specifically for scale-ups. The international accelerator and seed investment fund 500Startups exemplified this by launching 'Distro Dojo' in London, a three-month program for 'post seed' startups London.

Only recently has this funding gap been addressed by policy makers. Coordinated by Capital Enterprise and funded with a grant from the European Regional Development Fund, London at the time of writing will soon launch[77] the Capital Accelerate & Scale Tech Superstars program to support scale-ups in their growth ambition prior to applying for next round funding.

Finally, within any given entrepreneurial ecosystem the substantial variation in startup quality remains. As more people become interested, an increasing number of people with diverse backgrounds and needs are seeking information and entrepreneurial education. For instance, university students, early-stage researchers and recent graduates from the STEM-

[76] Source: https://journolink.com/release/the_london_tech_scenes_best_kept_secret_594 (last consulted on 01/11/2016)
[77] Source: https://www.linkedin.com/pulse/launch-londons-74m-programme-support-scale-up-london-tech-spindler (last consulted 01/11/2016)

fields[78] have recently been recognized as sources of new ventures. To this end, many universities are now adapting to facilitate this research-led commercialization by building pre-accelerators and active entrepreneurial communities. Leading universities such as Imperial College London and City University of London started to tackle the lack of entrepreneurial guidance by setting up pre-accelerator programs, respectively Imperial Create Lab and Fast Forward. Besides the offerings of leading universities in London (to fast-track academic entrepreneurs), structured pre-acceleration programs are also created as standalone entities or as part of established accelerator programs. Examples are Startup Next (powered by Google for Entrepreneurs and Techstars), Climate-KIC Greenhouse and Incubus London. The latter two pre-accelerators are backed by public institutions such as the European Commission, Tech City UK, and Digital Business Academy. These initiatives seek to empower aspiring entrepreneurs to become 'accelerator ready' in order to build up a thriving startup ecosystem. They do this by providing a 'sand box' with a lot of flexibility and space for creativity and allowing people to explore new innovative concepts.

DISCUSSION AND POLICY IMPLICATIONS

In this study, we have reviewed the evolution of the landscape of policy support for accelerators across national and regional/local levels and highlighted the role of institutional intermediaries. The diversity of accelerator archetypes has implications for policymakers in evaluating the role of accelerators and how to support them. First, rather than evaluating the effectiveness of all accelerators using the same criteria, there is a need to develop measures that take into account the different objectives of different types of incubation models.

Second, while accelerators may help solve some of the challenges relating to previous generations of incubators, they are not without shortcomings from a policy perspective. Policymakers focusing on regional development and employment objectives need to recognize that the accelerators they finance cannot be profitable in the short or even medium term. The ventures they invest in, the programs they have to develop in order to be successful in their objectives and their strategic focus on the local environment do not allow this. The systematic research evidence is sparse, but only investor–led accelerators in very dense ecosystems such as Silicon Valley and London appear to have a proven, sustainable business model. Unfortunately, we often see that policymakers expect ecosystem accelerators to have similar outputs as investor–led ones. However, accelerators designed to help create entrepreneurial

[78] STEM refers to Science, Technology, Engineering and Mathematics

ecosystems will only be even sustainable with continued financial support for a number of years. There is thus a need for policymakers to take a longer-term budget view of this form of support. Absent of this support, many accelerator initiatives are bound to disappear as soon as public finance is withdrawn. Otherwise, such accelerators are challenged to reconsider their incubation model in order to ensure longer term sustainability. For instance, the very first accelerator founded in Paris spent considerable time searching for an optimal model. It was established originally in 2011 as Le Camping, a publicly-backed entity, with a focus on employment creation and providing little financial support and not taking an equity stake in the ventures in the program. Subsequently it changed into a private accelerator fund, renamed Numa, replicating its model internationally through joint ventures with local partners such as in Casablanca, Bangalore and Moscow (for more information, see case study in the section below).

Although accelerators can be an effective way to shorten the startup journey, many potentially successful ventures may still not be investor-ready or commercially viable by the end of the accelerator program. Amidst an abundance of startup support programs, the existence of a void has been acknowledged on lack of early-stage funding for entrepreneurs in their so-called scale-up phase. As a compensatory mechanism, we are seeing an evolution whereby some accelerators are allowing alumni to remain in the premises after the program has ended. On the one hand, this may be indicative of a creep towards the problem confronted by traditional incubators of ventures failing to leave. On the other hand, it suggests that there may need to be policy development that either provides explicitly for continued active support within the accelerator and/or provides a connected ecosystem in which there are mechanisms for picking up still early stage ventures as they come off the end of the accelerator conveyor belt. In general, this focuses attention on the question of what are the funding and support gap(s) that accelerators are best placed to fill? Some accelerators, as we have seen, are now developing their support for scale-ups beyond the program and some accelerators specializing in scale-ups are also emerging. This being the case, accelerators represent developments that serve to broaden the funding and support landscape rather than simply being a new step in the traditional linear funding and support escalator. As such, to the extent that competition from the evolving forms of accelerators, provokes responses from more traditional equity providers to growing ventures there may be systemic benefits for entrepreneurs.

Taking into account the evolving forms of accelerators, perhaps the most notable trend has been the rise in corporate programs exhibiting a variety of forms and approaches. These programs are perceived to an important open innovation tool for corporates to search for

emerging technologies and talent. Another remarkable trend is the increased interest in building impactful science-based ventures that want to commercialize applied and fundamental scientific research. By providing substantive benefits, these emerging types of programs try to enable scientists to turn their inventions into ventures that are at the forefront of innovation such as personalized cancer treatments and algae-based biofuel. One such initiative, the London-based Deep Science Ventures, aims to support entrepreneurial activities taking place at technology frontiers through an experimental accelerator program to "skill-up" academic entrepreneurs (see case study in section below). However, science-based startups face greater constraints compared to the software and mobile startups being targeted by a traditional accelerator. The long development cycles and essentially higher capital requirements contradict the traditional characteristics of an accelerator – initially created to support fast moving digital startups (cf. Fedher, 2016). With policies that promote technology transfer to support spin-offs, regulation should consider how to create an entrepreneurial ecosystem that can fuel a boom in 'deep science' startups similar to the one observed in software and app spaces over the last decade.

Finally, in line with creating a connected ecosystem, institutional intermediaries have been proven to be useful to policy makers with the goal to create a resource munificent environment for entrepreneurial activity. Those intermediaries can help build supportive commercial infrastructures by interconnecting and facilitating cooperative and competitive challenges amongst ecosystem actors such as accelerators, incubators, crowdfunding platforms and early-stage investors. Besides coordination, such intermediaries tend to be well-positioned to shape the ecosystem through the preservation of the aligned interests between policy makers and practitioners.

Overall, we can conclude that policy is not just reacting to entrepreneurial ecosystem trends but is an active key stakeholder that through its accelerator policy, on different levels, revolutionizes entrepreneurial ecosystems to safeguard sustainable economic growth. But accelerators alone will not ensure successful growth of an ecosystem. It takes a more systematic approach for startups to thrive.

ACCELERATOR CASE STUDIES

Presented below are examples of accelerator models illustrating respectively the financing challenge accelerators encounter and an overlooked element in the accelerator scene. They differ in their program design as well as objectives. The program has been studied in depth through desktop research and semi-structured interviews with the program managers and participating startups.

Case study on financing challenges: NUMA[79]

NUMA Paris is the by-product of Le Camping, one of the first French startup accelerators in France. The initial concept of an accelerator program in Paris was developed at La Cantine in 2010, the first co-working space. It was recognized that early stage ventures search for more than office space such as hands-on (mentor) support to process information from the environment and give it meaning. Inspired by the Anglo-Saxon models, more specifically Startupbootcamp, and backed by a range of public entities, one of the first French startup accelerators in France was launched.

The accelerator program was established originally as a non-profit entity sponsored by Silicon Sentier[80] and strategic partners such as Orange, BNP Paribas and Google, before changing into an equity-engagement model and finally moving to an organization offering a range of services such as startup acceleration, corporate innovation consultancy, event management and co-working space. The first change was linked to a misalignment between the strategic objectives of the sponsors (both public and private) and that of the startups within

[79] https://paris.numa.co/en/ (last consulted on 24/11/2016)

[80] Silicon Sentier is a non-profit association founded by entrepreneurs in 2000 as an entity that stimulates networking between enterprises and embodies the digital identity in Île de France. It is sponsored by strategic partners such as R&D Orange, Île de France, Mayor of Paris and Cap Digital

the program. Although governance of accelerator can afford flexibility necessary to pursue goals beyond those of the main stakeholders, Le Camping's performance wasn't tied to its portfolio companies. After internal struggles, this resulted in a new investment scheme taking equity as little as 3% to ensure full commitment by the accelerator management's team for the support of their ventures. The second change goes along with a transformation into a for-profit entity (taking 5% instead of 3% equity), named NUMA, implementing an international strategy on top of its regional activities. After a successful crowdfunding campaign[81] and seed funding round collecting over €4 million, they target to open 15 programs worldwide and accelerate 700 startups. International programs in Bangalore, Moscow and Casablanca are jointly set up with local partners such as local business angel networks and governmental entities. The ambition is that by creating such an international network, each program can feed off one another.

The focus of the accelerator remained fixed on young and scalable digital startups and it selects per cohort on average 12 startups for an intensive four months' program followed up by two months of post program support. In regards to financial support, the accelerator initially offered a financial grant of €4.500 ("pizza money"), however this contribution changed into a €25.000 convertible loan after transforming in a for-profit entity. Such a scheme was preferred over a conventional capital increase as it entails complex and costly steps required by capital increase according to French company law.

By implementing a matchmaking model, the accelerator stimulates peer-to-peer networking between the startups, mentors, volunteers as well as industry and governmental partners. For instance, there is a direct collaboration with another Paris-based accelerator TheFamily that entails from sharing good practices with the stakeholders of the French entrepreneurial ecosystem toward sharing startups. Within the program, each startup is connected with one 'lead mentor' and a 'brother' chosen after a matchmaking event (speed dating). These two types are guiding the participating startups in their search processes for their optimal product-market fits. Typically, those two mentors are business mentor with specific industry expertise and a product mentor with prior entrepreneurial experience. The other role of the mentors is to give the core team of the accelerator the red flags of which startup isn't performing well.

In addition, the program hosts events such as 'Adopt a CTO' which is a specific networking opportunity to connect technical-skilled individuals with aspiring entrepreneurs,

[81] https://yeswecrowd.co (last consulted 29/11/2016)

and training sessions open for external partners to stimulate innovative activities. In this way, NUMA Paris is pursuing its mission to put in place tangible schemes and pooled resources for the benefit of innovation, while favoring the development of a network dedicated to different players in the digital sector.

From 2015 onward, they have worked with 30+ large corporates to carry out their digital metamorphosis which generated more than €2.5 million in annual turnover and accelerated 76 startups who have raised over €30 million.

Case Study on accelerating impactful science-based ventures (London): Deep Science Ventures[82]

Deep Science Ventures is a fully-funded, full-time program launched in the summer of 2016 which works with scientists to make the transition from technical expert to founder of a high-tech startup. It aims to build a community of interdisciplinary scientists, industry experts and high-tech focused investors to build the next generation of high-growth science based ventures. It is based on the success stories of Imperial Create Lab, a pioneering pre-accelerator program at Imperial College London and Entrepreneur First, a technology accelerator and training school for entrepreneurs. Both programs acknowledged the potential of UK's talented scientific staff to tackle real world challenges and have the clear objective to 'skill-up' (academic) entrepreneurs and start building companies from scratch by alleviating most of the risks.

As they focus on aspiring entrepreneurs with specific technical expertise, their approach is different compared to the more typical web-tech or digital focused accelerators. The concept behind Deep Science Ventures is supporting individuals rather than fully-formed teams and the program is designed in two stages: (1) a three-months educational program providing individuals with intensive learning and supplemented with an equity-free cash infusion (i.e. 'monthly stipend). As individuals tend to possess (only) technical capabilities, they are likely to have inadequate skills to create a technology-based venture i.e. business capabilities. The aim of this stage is to develop an idea whilst receiving entrepreneurship know-how input, meet like-minded people and form a company based on a technology application or solution solving a 'grand challenge'. Educational workshops cover topics such as customer development, financial modelling, design thinking, patent strategies and transferrable skills; (2) early-stage ventures enter (if selected) a second three-month phase, where the accelerator invests £30K for

[82] http://deepscienceventures.com (last consulted 01/11/2016)

an equity stake of 15%. Participants need to have a validated idea of the commercial side and a prototype in order to make the transition into stage 2.

This unique accelerator reduces risks by providing substantive benefits in the form of weekly mentoring, unique high-tech prototyping facilities (by partnering up with SynbiCITE[83]), such as wet lab facilities, and sector experts. Participants can apply and choose between two tracks:

- Industrial brief model is designed to present challenges which are generated by the venture partners, sponsoring corporates such as Jaguar Land Rover, Arup and the program team itself who has selected "grand challenges". These are highly significant yet potentially solvable problems such as antibiotic resistance, intelligent and personalized healthcare and global famine. They affect vast numbers of individuals in often profound ways. As they may require working across disciplinary boundaries to solve technical problems, Deep Science Ventures implements a structured approach to gather talented individuals to ideate and validate potential concepts with end users and field experts.
- Cohort thought leadership model whereby participants with specific technical expertise conduct workshops laying out the current developments of cutting-edge technology and stimulating schooled peers within the program to creatively think about certain opportunities or viable market applications. Examples are next generation computing infrastructure, space technologies, cellular agriculture etc. This model is based on the so-called 'cohort-peer effect' whereby founding teams learn indirectly from the experience from others (see Hallen, Bingham & Cohen, 2014). It is an approach that has been designed to stimulate the formation of multi-disciplinary founding teams which tend to identify a larger number and more varied market opportunities.

Furthermore, the program team supports participants in obtaining public resources such as grants. They also impose regular meetings with founding teams which serves as a way to commit participants towards the achievement of business milestones (Gonzalez-Uribe & Leatherbee, 2016). Although it looks promising, Deep Science Ventures is only currently running their first program and could be perceived as an accelerator experiment focused on high-technology ventures. A sneak peek at the cohort tells us participants are working on

[83] http://www.synbicite.com (last consulted 24/11/2016)

technological matters from advanced materials based on algae biofuel waste to low-cost transistors for DNA sequencing.

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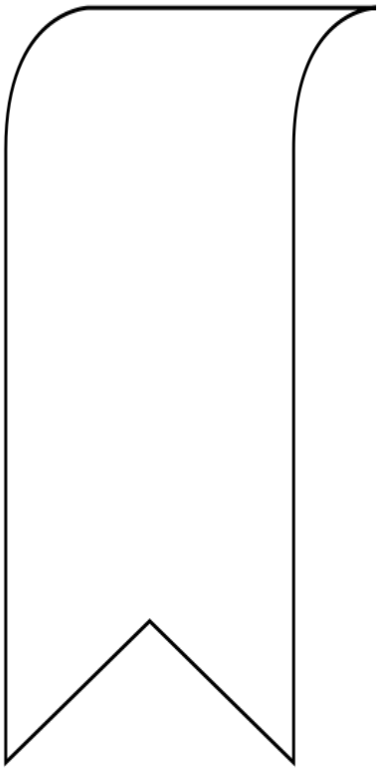

STUDY 3

TO FIDDLE AROUND WITH THE STARTUP ENGINE: THE ROLE OF ACCELERATORS IN VENTURE LEARNING AND EXPERIMENTATION

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ABSTRACT

Prior research on accelerators tends to empirically examine the impact of acceleration on venture performance and its direct link to certain mechanisms. However, an important and under-examined issue is how these mechanisms impact acceleration outcomes such as a venture's investor readiness. I investigate this largely unexplored question by looking at the relationship between acceleration, an experimental learning approach and acceleration outcomes across three indicators of venture performance. While all the ventures receive the same accelerator treatment, I identify the emergence of two increasingly divergent learning paths over time, culminating in different venture outcomes upon exit of the accelerator program. I contribute to the incubation literature by revealing a more nuanced view of how learning occurs in an accelerator and links to venture performance and by demonstrating the power of an accelerator to shape a venture's commercialization approach.

Keywords. acceleration, experimental learning approach, lean startup, venture performance

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INTRODUCTION

Business accelerators are the latest and most famed incubation models aimed at stimulating new venture development and subsequent growth (Mian, Lamine & Fayolle, 2016; Pauwels, Clarysse, Wright & Van Hove, 2016). They rapidly became a global trend, illustrated by the 50%-year increase in the number of business accelerators between 2008 and 2014 in the US alone (Hathaway, 2016). The core design of an accelerator program evolves around the idea of 'pressure cooking': aspiring entrepreneurs with a more or less clearly defined idea are put into a time-constrained program built around the principles of lean startup with the aim to rapidly validate an opportunity and help transform an idea into a sustainable business (Hathaway, 2016; Kohler, 2016; Nesta, 2014). In line with their increased importance, there is also an emerging academic literature investigating the phenomenon of accelerators (Pauwels et al., 2016; Gonzalez-Uribe & Leatherbee, 2017; Aaboen, 2009; Lamine, Mian, Fayolle, Wright, Klofsten & Etzkowitz, 2016).

This literature has provided important insights into how accelerators operate and the sort of services they provide to help startups develop. However, there is surprisingly little research on what the ventures that participate in such an acceleration program learn from these services and how this learning translates into improved performance. Some empirical work in the incubation literature has indicated that successful incubation relies on the different interactions with the management team or the incubator's network that enable ventures to learn about the market and the technology (Scillitoe & Chakrabarti, 2010; Hackett & Dilts, 2004; Bøllingtoft & Ulhøi, 2005). However, we don't understand how these ventures actually learn from interacting with the management team and the network of experts (Hughes, Ireland & Morgan, 2007). Moreover, I observed that the accelerator model—which is to some extent standardized—is being adopted to support all types of ventures (Hochberg, 2016). As different types of ventures typically face different challenges (e.g. Ambos & Birkinshaw 2010), I would expect that startup acceleration is unlikely to take place in a similar fashion. This leads us to the following research question: *How do early-stage ventures effectively learn from the services offered in an accelerator program, and (how) is this relationship affected by venture characteristics?*

Thus, the objective of this study is to peer inside the black box of accelerators, by examining what actually affects venture performance and how this relates to learning. The nature of my research question and the current state of the related literature indicate that a qualitative research study suits my research objectives. Given the limited theory and empirical evidence on learning in accelerator programs, I opted for a multiple case study approach in the

setting of a unique program that emulates the philosophy of acceleration in their mission to support new ventures. To maintain consistency throughout the paper, I define accelerators as cohort-based temporary programs that certify the value and accelerate the learning of new ventures (Hoffman & Radojevich-Kelley, 2012; Cohen, 2013; Kim & Wagman, 2014; Hochberg, 2016; Pauwels et al., 2016). The uniqueness of accelerators compared to other startup support initiatives is the concept of accelerated learning which can be defined as "learning that happens faster than it would under typical conditions" (Cohen, 2013:18).

I contribute to the existing incubation literature by drawing associations between acceleration outcomes across three indicators of venture performance and an accelerator's learning environment, while considering the characteristics of admitted ventures. Hereby, I reveal the boundary conditions of traditional acceleration. This study adds to prior learning research that favors experimentation by questioning the consequences of the lean startup method. The results of this research also put some of the hype around acceleration programs into perspective and help us better understand what type of acceleration outcomes can and cannot be expected. In doing so, this research not only inspires further research on how ventures are accelerated, it also contributes to practice by providing valuable insights for acceleration program managers on portfolio strategies and policy makers considering to fund accelerators. Overall, I enrich the conversation on how to design effective accelerator approaches, taking into account the heterogeneity of ventures.

BACKGROUND

The genesis and evolution of accelerators

Using a distinct incubation approach, accelerator programs have been acknowledged to be a new organizational form that provides a number of resources critical for the development of early-stage startups (Fehder, 2016; Cohen, 2013; Bone, Allen & Haley, 2017; Bernthal, 2016). Accelerators now profile themselves as a form of business schools for entrepreneurs, alternative funding and business creation vehicles and they promote their programs as instruments to tackle digital disruption in the corporate world (Gonzalez-Uribe & Leatherbee, 2017; Lamine et al., 2016; Drover, Besenitz, Matusik, Townsend, Anglin & Dushnitsky, 2017; Weiblen & Chesbrough, 2015). Accelerators differentiate themselves from incubators by providing knowledge intensive support services (Pauwels et al., 2016) and by forcing startups to quickly face business realities to determine whether the business is viable (Hochberg, 2016; Isabelle, 2013). Inspired by the very first accelerator Y Combinator, which was established in 2005 in Cambridge, Massachusetts, accelerators have been proliferating across the world

(Miller & Bound, 2011; Hochberg, 2016; Shane, 2016). For example, the United Kingdom alone has been claimed to host currently upward of 163 accelerators, which is a steep increase from around 10 active programs in the whole of Europe in 2011 (Bone et al., 2017; Miller & Bound, 2011). The ongoing demand for the launch of accelerator programs has been explained by the startup's need for knowledge-intensive services (Hansen, Chesbrough, Nohria & Sull, 2000) and the convergence of factors in information technology and capital markets (Mian et al., 2016).

Notably, accelerators have predominantly been created to support fast-moving digital ventures (Fedher, 2016; Cohen, 2013; Konczal, 2013) but the accelerator landscape has been evolving ever since. This evolution has been partly driven by policies promoting this model as a way to broaden the funding landscape as well as the continuously increasing interest from investors (and even corporates) in this organizational innovation to improve the startup financing process (e.g. Hochberg, 2014; Shane, 2016; Bone et al., 2017; Sivonen, Borella, Thomas & Sharapov, 2015). To illustrate this evolution, some established accelerators such as Y Combinator started to adapt its admission criteria and develop a more heterogeneous venture portfolio. Formerly admitting only software-centric startups into their cohorts, this well-known program has been recently supporting a supersonic passenger airplane startup[84] and a startup converting plant sugars into hydrogen peroxide[85]. Unlike digital technology startups of which most innovations are based on established programming languages and architectures, ventures attempting to commercialize scientific advances are typically constrained in their ability to prototype and use of iterative experiments because of their higher development costs coupled with a long cycle time (Miozzo & DiVito, 2016; Lubik & Garnsey, 2016; Harms, Marinakis & Walsh, 2015; Pisano, 2010). Thus, one may wonder how the logic of increased learning and accelerators, arguably designed for software and mobile startups, applies to a heterogeneous set of ventures.

As new accelerators programs are emerging to support all kinds of ventures, the potential implications of heterogeneous portfolios may change the output of an accelerator in regards to its impact on venture performance.

The impact of acceleration on venture performance

Evidence on the effectiveness of accelerator programs in helping ventures raise new capital has long been scant due to the newness of the accelerator phenomenon and the poor quality of and

[84] http://www.wired.co.uk/article/virgin-supersonic-travel, last consulted on 02/08/2017
[85] https://techcrunch.com/2017/03/20/yc-demo-day-winter-2017/, last consulted on 02/08/2017

limited access to accelerator data (Hochberg, 2016). The significant heterogeneity which exist between accelerator groups that meet the formal accelerator definition as well as the high level of heterogeneity amongst ventures in an accelerator portfolio also complicates impact research.

To the best of my knowledge, only three studies have so far attempted to compare the performance of ventures that completed accelerator programs to other ventures that did not (fully) attend accelerator programs. First, Hallen and colleagues (2014) found evidence that accelerated ventures beat their non-accelerated counterparts in speed for reaching two key development milestones i.e. raising an initial round of venture capital and reaching high-level of customer traction (as measured with web traffic). Notably, their analysis only included "Internet-related ventures" and the results suggest that some accelerators accelerate more than others.

Second, Gonzalez-Uribe & Leatherbee (2017) complemented this study by providing quasi-experimental evidence of the effect of accelerator programs on new venture performance, measured as the probability of raising funds, the amount of capital raised and the increase in employees. They concluded that ventures receiving a combination of mentoring, networking, capital and co-working space performed better than those only receiving capital and space. Their results highlight the key role which the provision of mentoring and networking play in venture acceleration. Mentoring and networking are argued to complement the limited amount of founding team experience. They find that mentoring and networking are even more important in digital startups, defined as ventures in software and mobile.

Third, Roberts & Kempner (2017) got similar results using data from over 2000 ventures from 42 acceleration programs in developing countries. They revealed that accelerators in emerging markets are positively impacting ventures in their mission to raise funds compared to their non-accelerated counterparts.

According to Wise & Valliere (2014), this beneficial effect of accelerators on the failure rate hazard of tenant ventures depends on the direct startup founder experience available in the accelerator management team. Along these lines, Goswami and colleagues (2017) have argued that the expertise residing within an accelerator—such as the capability to align with the needs of ventures and foster relationships between ventures and the ecosystem—influences venture development (success or failure). In sum, while there is some empirical indication that accelerator programs do have a positive impact on the average performance of young ventures after graduation through the provision of various forms of experience in mentoring and networking programs, it is unclear *how* such mentoring and networking translates into better performance, in other words how these ventures learn from these services.

The main body of research on incubation claims that technology business incubation models create an environment that is conducive to learning (Eveleens et al., 2017; Bøllingtoft & Ulhøi, 2005) and that it accelerates a venture's learning process (e.g. Bruneel, Ratinho, Clarysse & Groen, 2012). Startups learn when they acquire different types of knowledge by interacting with various (external) actors such as the network of the program, mentors and the management team. For example, incubated ventures acquired technological know-how from interacting with external contacts, facilitated by the management of the program (Scillitoe & Chakrabarti, 2010), while business and market knowledge was collected from interacting with the incubation management team as well as mentors and external contacts (Hughes et al., 2007). This acquired knowledge can then contribute to venture performance. For example, Sullivan & Marvel (2011) found empirical evidence that by relying on networks, incubated ventures enhanced the positive effect of acquired market and technological knowledge on outcomes such as innovativeness and venture sales.

Overall, these studies are primarily focused on whether ventures acquire knowledge in traditional incubation models and its link to venture performance. But it does not address what actually happens in an incubation model or how learning is stimulated. Furthermore, the research on incubation and learning tends to make the implicit assumption that ventures incubate equally and homogeneously (cf. Hughes et al., 2007). Considering an accelerator is a new generation incubation model and taking into account the heterogeneity of the venture portfolio, I attempt to address this gap.

METHOD

Given the limited theoretical insight about this phenomenon, I used a multiple-case qualitative approach (Eisenhardt, Graebner & Sonenshein 2016). More specifically, I investigated what happens within an accelerator by looking at how ventures, steered by the accelerator's management team and the network of mentors, made changes to their business model during the period of acceleration.

Research setting

I conducted my study in one of the five Knowledge and Innovation Communities (KICs) set up by the European Institute of Innovation and Technology (EIT), an EU body assigned with creating sustainable European growth while dealing with climate change. One of the approaches to ensure Europe's growth ambition has been the creation of the Climate-KIC (CKIC) accelerator in the United Kingdom. The CKIC accelerator is a university technology

accelerator (see Byrd, Herskowitz, Aloise, Nye, Rao & Reuther, 2017). Inspired by the model of Y Combinator and using a combination of business model canvas methods, agile development, and customer discovery, it pushed ventures to validate a product-market combination and pivot (if deemed appropriate). The CKIC accelerator has as a clear goal to prove the feasibility and transform cleantech ideas into investable business cases. Like most accelerators, CKIC focuses on mentoring and networking, alongside a supportive peer-to-peer management team and pre-seed investment grants (cf. Isabelle, 2013).

However, in contrast to accelerators mainly focused on the digital community, this program admits a heterogeneous set of ventures, has longer time frames and open learning milestones. A key member of the accelerator management explained that the program "*was designed to accommodate all types of ventures*" and how "*the variable length feature offers startups the extra agility they need to make additional pivots without being artificially constrained by time*". By removing the fixed-term element, the program allowed ventures to pivot until they lock-in on a superior product-market combination. Ventures were treated as open-ended iterative experiments, and learning was a key priority in the review and funding process. With learning as the unit of progress, participating ventures were specifically evaluated based on the learning milestones they achieved through the program. The elapsed time to reach these milestones can thus vary depending on one's learning progress. For instance, the first milestone stipulated to draw out a hypothetical business model canvas and a strategy to validate its main assumptions while the last one required ventures to have evidence showing product-market fit and traction.

Overall, the program followed a milestone approach linked with a grant funding mechanism open to academic researchers, students, and external entrepreneurs. This 'carrot and stick' approach created a balance between giving a venture enough autonomy to thrive while maintaining links with the program. The program's intended (learning) outcome was described by the accelerator management as an approach "*to ensure that teams who complete the program have a clear focus on the specific markets and value propositions that will enable them to raise meaningful external investment*". An overview of the accelerator package, its process and the most important elements as perceived by the participating ventures can be found in Figure 1 and Table 1. Because of its specific focus on learning, I consider it to be an ideal context for my research purposes.

Please insert Figure 1 here

Please insert Table 1 here

Data collection

I conducted an in-depth multiple case study of eight new ventures that participated in the CKIC accelerator. Each of the admitted ventures aimed to assess the feasibility and profitability of a new and ill-defined cleantech product concept. The similarities in terms of context (thereby reducing unobservable external factors) enabled us to study and compare ventures for any differences in their development while undergoing the same accelerator intervention. I used purposive sampling to identify venture participants that offered the most efficient access to data. I collected data from multiple sources such as interviews, private milestone reports, and publicly available secondary databases to strengthen the accuracy of my findings (Eisenhardt & Graebner, 2007).

I cooperated with a key member of the accelerator management team, the accelerator coach, to identify the ventures in the sample that had shown sufficient variance on three acceleration outcomes: First, the final score of the venture's investor readiness, measured by the accelerator management team upon graduation. This is a subjective score that reflects the ability of a venture to attract significant external investor funding from venture capital funds and/or business angels. Second, I selected ventures that showed variation in acceleration time defined as the elapsed calendar time each venture needed to complete the two distant learning milestones of the program. Third, I looked for variation on a post-hoc performance measure by identifying any successful fundraising events to triangulate the subjective scores by the accelerator (see Appendix A). The triangulation on the three acceleration outcome dimensions resulted in 14 ventures (out of the 47 ventures in their portfolio at the time), predominantly in the business model discovery and validations stage, of which eight were willing to participate in interviews and share internal documents. A detailed description of the cases and overview of the data obtained can be found in Table 2 and Table 3.

Please insert Table 2 and 3 here

I relied on three data sources to construct the learning paths of the selected ventures: (1) venture-specific documents like the application form, strategy documents, acceleration-specific objective measures on venture performance, progress presentations to accelerator management; (2) semi-structured interviews with entrepreneurs who founded the ventures and the accelerator coach who was responsible for tracking the progress of the specific venture; and (3) publicly available information like media sources such as Twitter and Facebook account data, company press releases, recorded competition pitches and magazine articles. The use of traditional and contemporary data sources likely improves depth which enables more accurate abstraction levels (Eisenhardt et al., 2016).

Prior to each semi-structured interview, information about the firms in the private sources was analyzed as well as data published in secondary sources. This helped us both to track events such as changes in the business model that guided our probing during the interview. With regards to the semi-structured interviews, I contacted the principal founder as the "primary source" of information in addition to the coach responsible for tracking the progress of the specific venture. According to Jong and colleagues (2013), the principal founder enjoys considerable power in key decision-making because of the small size of operations. Examples of key decisions in my case are the application choice and the identification of potential end users.

In total, I conducted 25 semi-structured interviews, all recorded and transcribed (see Appendix B). Such interviews have shown to lead to higher accuracy in interpreting retrospective reports (Miles, Huberman & Saldana, 2014; Graebner & Eisenhardt, 2004). Informal meetings were also held to discuss the process and the output of the accelerator program from inception until 2015. This led to an intimate understanding of the program and its portfolio ventures. The reliance on two (key) informants for each venture, who both covered the whole or significant parts of the venture's learning journey in Climate-KIC, mitigated potential retrospective biases (Golden, 1992; Miller, Cardinal & Glick, 1997).

Data analysis

My analysis relied on a process of abductive theorizing. This reflective process is based on scholars having an inductive hunch or insights originating from the data, which is then coded, categorized and reflected upon with theories to explain the puzzling observations (Locke, Golden-Biddle & Feldman, 2008; Mantere & Ketokivi, 2013). New insights are iteratively generated from the interplay between the increasingly refined coding schema and the literature. The data analysis consisted of several stages. Consistent with multiple-case analysis

(Eisenhardt, 1989; Miles & Huberman, 1994), the study began with synthesizing and condensing the data for each firm to develop individual case histories. I identified the actions taken by my interviewees and triangulated these with my (real-time) archival data – the various internal documents and the collected media coverage – in order to build a venture-level chronological list of events. This resulted in a sequence of qualitative information where I explained incidents with raw data to visualize the development of each business model (Van de Ven & Poole, 1990). Like others (Markides, 2013), I noted that the business model is made of interdependent activities such as the firm's value chain activities, its choice of customers and the value proposition defined as the product-market combination.

In the second stage, I analyzed the individual case histories and conducted a cross-case analysis. I discovered that, despite going through the same acceleration program, ventures developed differently. To probe my hunch, I centered the analysis on uncovering the drivers of these different patterns of development. After some data-theory iterations, I began to explore the literature streams which have placed learning and experimentation at the heart of the entrepreneurial process (Ries, 2011; Blank, 2013b; McGrath, 2001; Kerr, Nanda, & Rhodes-Kropf, 2014) to understand why ventures experience different acceleration outcomes.

Subsequently, I coded practices associated with the lean startup method and subsequent learnings. This methodology constitutes of three basic elements: (1) the business model canvas to articulate core hypotheses generated for major business model elements such as a new venture's unique customer value proposition (Osterwalder & Pigneur, 2010), (2) the customer development process on how to gather data as rapidly as you can to validate these hypotheses (Blank, 2013a/b), and (3) agile engineering which enables you to create a product in an iterative fashion using a minimal viable product (Iansiti & MacCormack, 1997; MacCormack, Verganti & Iansiti, 2001). The lean startup method has priors in various management approaches, such as for example discovery-driven planning (McGrath & Macmillan, 1995), purposeful experimentation (Murray & Tripsas, 2004) or lean thinking (Womack & Jones, 1996) and is marked by concepts like iterative experimentation, continuous learning, and rapid development cycles. It is described as a method for entrepreneurial learning (Harms et al., 2015) and has been advocated by accelerator programs because it enables them "to grow a business with maximum acceleration" (Ries, 2011).

Specifically, I coded practices by building on the assumption that key learnings were translated into direct actions and changes within the business model (cf. Fiol & Lyles, 1985). I identified and analyzed any changes made in a venture's product-market combination over time based on the experimental actions taken by the venture like the use of prototypes or

interactions with the market. This helped us to develop the learning trajectories or paths of the ventures reflecting the lived experience of the ventures. I used the concept of a learning path being the sequence of actions taken, such as interactions with the environment and the business changes (as a product of learning) a venture undergoes while pursuing a vision, starting from their entry into the accelerator program.

I subsequently discerned how the acceleration treatment affected the learning path of the venture. I contrasted the cases and mapped out the similarities and differences in terms of their learning paths and their individual characteristics. Specifically, as I iterated among case pairs of successful and less successful ventures and read my interpretative notes made during the analysis through the lens of these analytic concepts (lean startup practices and learnings), I began to capture the relationship between the meaningful variation in acceleration outcomes, ventures' learning paths and their characteristics. I also used investigator triangulation, as multiple investigators were involved in data collection and analysis (Eisenhardt, 1989). For instance, one author was deeply immersed in the data collection while another read the original data and provided an independent perspective on it.

FINDINGS

I attempted to explain the variance in acceleration outcomes by looking at (1) how the ventures effectively learn from the services offered in an accelerator program and (2) how this relationship is affected by venture characteristics. As indicated in Table 4, there were substantial differences across ventures in terms of performance, indicated by three acceleration outcomes. Four ventures (SPACE, GLUE, PRINT, and CAPS) were successfully accelerated. On average, each venture was performing better than the 'gold standard' on at least three out of four dimensions in terms of investor readiness. Their average speed to reach the requirements of the learning milestones was high and they were successful in raising considerable funding after graduation. In contrast, four other ventures (HEAT, SOLAR, MAP, and NEST) were less successfully accelerated. Their acceleration outcomes were, on average, much lower than those of the first four firms.

In attempting to understand these differences, I found that ventures that are effectively accelerated embark on a variance-creating learning path that is characterized by parallel business experimentation and the development of a portfolio of product-market combinations. In so doing, they outperform—in terms of investor readiness, speed of acceleration and post-hoc fundraising—those who did not implement a wider approach i.e. consciously keeping

related market options open. In the next sections, I elaborate on these insights and describe their grounding in the data.

Please insert Table 4 here

Organizing experimentation process to learn

What emerged from the data were insights that linked the accelerator intervention with an experimental learning approach adopted by admitted ventures during their pursuit of a winning product-market combination. Upon entry in the program, ventures were forced to search for and gather valuable market feedback which was subsequently used to guide venture actions in the next iteration much like the lean startup principles and its use as a mechanism to inform future actions. By favoring actions to engage with customers and embrace feedback over actions to perfect the technology, plan and tinker with the business model, the accelerator was seen as "*an enabler*" that pushed ventures "*to forget about making sure everything is perfect*" according to the founder of MAP.

The accelerator coach described it as follows: "*We use the Lean Startup to help our ventures validate the markets they have selected and use it to really drill into the value proposition by testing the market*". To exemplify, the accelerator coach pointed out that this method helps ventures in their search for finding a viable business model by enabling them to "*reconfigure the business model and technology until it sings a beautiful song that tops the charts*".

The data indicate that each venture enacts the lean startup principles using interrelated activities that permits flexibility to execute and change (components of) the business model strategy (see Table 5). That is, ventures attempted to investigate the environment in an iterative manner by 'getting out of the building' and test assumptions to validate, adapt or abandon the business model using prototypes. Consequently, key learnings from these actions were translated into changes which ranged from incremental shifts in the go-to-market plan to technical iterations and even a pivot in the product-market combination itself.

Please insert Table 5 here

The data suggest that both successful and less successful ventures executed incremental and fundamental changes (if deemed appropriate) in order to achieve a stronger product-market combination. For instance, the venture CAPS reconfigured its initial application for agrochemicals after facing difficulties to overcome regulatory hurdles. Subsequently, once CAPS recognized that "*agrochemicals is just a massive challenge with too many regulatory steps",* it pivoted and started to target the household care sector by developing a new type of liquid laundry detergent based on its encapsulation technology. Others only did some minor tweaking of the business model such as changing the cash flow formula, peripheral product features around the core technology, and/or targeting a new market segment. For instance, the accelerator coach of the program commented on how NEST fine-tuned its business model:

> In the case of NEST, where they got to is that the value proposition was most valued by "multi-site" corporates. It was a business model point of clarification. And they had proof because the customer had placed an order. (comment by the accelerator coach on the changes in the business model of NEST)

This flexible process of change, induced by feedback, can also be described as 'tuning the startup engine' (Ries, 2011:23). Instrumental to this process were the demonstrator projects or pilot tests with minimum viable products and early prototypes each venture developed. These non-productized versions of the solution are useful to let customers experience it, and simultaneously "*accelerate that sort of thinking about the market*" and "*learn about the technology*" as the founder of CAPS explained.

Importantly, this experimental learning approach was directly linked to the learning milestones of the program (see Figure 1). It was a way for the accelerator to commit entrepreneurs towards the achievement of learning goals such as proving that the venture had "*locked-in on the market*" according to the accelerator coach. This is in line with speculations in previous research conducted by Gonzalez-Uribe & Leatherbee (2017) which suggested that accountability as an accelerator mechanism could affect venture performance. That is, by being held accountable, ventures may become more persistent in the pursuit of a winning product-market combination and as the founder of SOLAR said, "*to push and steer the business that would get us to the bigger picture.*" A founder in my sample seconded this statement by highlighting the importance of the milestones:

> The fact you have to jump over things, is a good thing. They expect you for passing these stages that you talk with customers and see what they think. So, actually that you have face-to-face meetings with the real world. It pushes you to get into contact with the real world where you are getting real feedback. And some companies are not going to do it. You know, they are not

going to do it, because they have a technology that doesn't work or they get things not going. (GLUE, interview founder)

To conclude, the accelerator and its design prompted the use of experiments, including hypotheses, to test assumptions (directly) in the market so that admitted ventures execute opportunities in a flexible manner. This helps ventures to learn more quickly in their mission to develop a winning product-market combination. I therefore suggest:

Proposition 1: Participation in an accelerator program leads to higher execution flexibility, so as to accelerate the development of a viable product-market fit.

Differences in learning paths: sequential and parallel experimentation

All ventures in my study entered the accelerator with the common desire to search for a winning product-market combination. Once in the accelerator, they underwent the same accelerator treatment which imposes a guided experimentation framework that stimulates iterative and flexible development of the solution. Yet ventures seem to respond to the treatment in different ways over time. Analysis unraveled differences in the learning paths depicted by the experimental learning actions of each venture. More specifically, the distinctiveness can be found in the selection of opportunities and the associated trade-off between focus and flexibility. The identification of these patterns in the learning paths of ventures is indicative for the variance in a venture's acceleration outcomes.

I found that ventures being more effectively accelerated (~ SPACE, GLUE, PRINT, and CAPS) engaged in variance-creating behavior by pursuing a product-market strategy which tests multiple business models in parallel. Based on the discovery of unanticipated customer demands, these ventures acted opportunistically rather than following a narrowly defined experimental path in a single market. For instance, the founder of CAPS admittedly stated that they "*get excited about different things as we go along*". Even though the main responsibility of the ventures in the program was to work on the initial business model and adapt it accordingly, their engagement in practice included the generation and pursuit of new technological ideas.

By leveraging the new information that was uncovered through its experimentation within the market(s), ventures were enabled to both select and execute alternative product-market combinations in a flexible manner. That is, armed with market information, market uncertainty was lowered to acceptable levels before the decision was made to explore (related) alternatives. This 'reinforcing association' between execution and the selection of

opportunities is clearly illustrated by the founder of GLUE while he described how a new product-market combination emerged:

> We discovered that the resin that we make is very good at binding straw. This discovery came out of our talks with another competitor, based in Holland. They tried to get things moving for about four years with a board made out of straw and it came down to the problem that their product is too expensive. Now we produce straw pallets. (GLUE, interview founder)

Thus, the experimental learning approach, aimed at enhancing the feasibility of the original idea, actually created new (growth) options as opposed to limiting alternatives. Moreover, the rationale behind this additional 'explorative focus' to seize alternative product-market combinations in parallel was with the intention to strengthen a venture's foothold in existing markets and establish a presence in new markets. The founders of SPACE and CAPS explained their pursuit of alternatives as a strategy to stay "*ahead of the curve*" and create more options:

> The more we remain if you like ahead of the rest of the curve, in terms of developing new and interesting products, the less likely that we would get catastrophically compromised. (SPACE, interview founder)

> Ideally, we would like to have products in everything. We are sort of de-risking by making sure there is always a back-up plan. It is a big long process to commercialize a new chemical into a product on the shelf that the public will touch. So, we have to keep looking at opportunities and with as little of work possible, take it as far as possible. If that makes sense whilst staying focused. I know that sounds strange but that is how it is. (CAPS, interview founder)

In so doing, SPACE started to shift the position of the business from pursuing a single product-market combination to sticking to a mission statement that states "*we are in the business of building applications*". Whereas, CAPS clearly choose to design experiments with the aim to create real options even if a particular experiment fails (cf. McGrath, 1997). Overall, SPACE, CAPS and other ventures exhibiting variance-creating behavior graduated from the program with a portfolio of product-market fits.

In contrast, some ventures (HEAT, SOLAR, MAP, and NEST) did not deviate and remained focus in their attempts despite receiving the same accelerator treatment. Instead, they followed the typical sequential process of the lean startup method that hones in on and deepens initial insights in an attempt to achieve a specific product-market fit. In other words, these ventures adopted a single product-market strategy characterized by incrementally fine-tuning the application to the needs of the market. Although the venture might not focus on a single market segment over time, the experimental process was sequential in nature.

For example, HEAT pursued initially a luxury shower concept but radically changed the concept once it was clear that the solution wasn't generating any traction. It retained its overarching vision, however, through continuous learning and by listening to potential customers they identified an alternative idea inspired by 5G heat networks:

> We tried to develop a sort of luxury shower where we wanted to recover the heat from the water with a specific technology. Sort of drain water heat exchanger. After 6 months it became clear, we did not have a value proposition that was compelling enough to our target market. Talking with our target market and discussing their needs, they were describing their heating as a larger need. And we pivoted to provide small-scale heating solutions. The end goal is still similar. The target market is still similar, social housing and new build but the approach is different now. (HEAT, interview founder)

After this substantive forward-looking decision to change the product concept, HEAT started to build a demonstrator project and interact again with various stakeholders to ensure what they were building is what the market wanted. Similarly, MAP experimented with their software-as-a-service model that deals with the energy efficiency of buildings. The founder of MAP reflected that by "*circling around what the different customers could be*" and validating how the venture is going to create value, it had to "*switch gears*" after each experiment cycle. Basically, MAP had to re-orient its vision and develop another business model as a response to feedback. For instance, it had to abandon the idea of getting governments to pay for the software and start to develop a lead-generating tool for energy product suppliers.

The approach at HEAT, SOLAR, MAP, and NEST was thus a structured sequence of iterative cycles of experimentation to learn as much as possible at the lowest possible cost. As each step was completed, feedback on the business model was useful because it informed future actions and pushed experimentation further. Staying focused on testing a single solution directly in the market and collecting feedback, enabled these ventures then to revise its business model over time, reach its learning milestones and graduate the program, albeit with a lower performance score.

Thus, even though the accelerator's experimental learning approach i.e. the lean startup method has been adopted by each participating venture, some ventures seemed to adhere to a step-wise or sequential experimental process as prescribed while other did not. Moreover, those who did not and instead started to test alternative product-market combinations in parallel seem to have an instrumental benefit of creating more value across a range of industries and applications. This variance-creating behavior, characterized by the flexible selection of opportunities, allowed ventures to simultaneously gain familiarity with various product-market

combinations before major investments are made. Consequently, these ventures were able to build better models more quickly than their slower counterparts that attempted to focus on a specific solution by improving the mean performance (cf. McGrath, 2001). This resulted in a high investor readiness of the accelerated ventures. We therefore suggest:

> *Proposition 2: Participation in an accelerator program leads to higher selection flexibility, so as to accelerate the development of a product-market portfolio and increase a venture's investor readiness*.

I have selected two contrasting cases (SPACE and HEAT) to better visualize the differences in learning paths in regard to their product-market strategy (see Figure 2). The displays of the other ventures are also available upon request from the authors. I explore in the next section why certain ventures were more prone to 'stick' with the step-wise lean startup process (i.e. low selection flexibility) compared to others.

The (unintended) variance-creating behavior in a lean startup accelerator

But why don't ventures accelerate equally and homogenously? The fact that all ventures experienced the same treatment raises the question why acceleration was more effective for some than others? I now turn to explain why ventures espoused a different learning behavior by zooming in on the trade-off between focus and flexibility during the selection of (new) product-market combinations.

Prior market knowledge of the venture

The analysis points out the crucial role of prior knowledge in explaining the differences in a venture's learning path. All ventures possessed an average to high technological knowledge but it was clear that the less performing ones had prior experience in the market it was operating.

I measure the venture's prior knowledge by coding the venture's experience-based knowledge. The information for coding the knowledge was derived from LinkedIn profiles, company web page bios, and interviews. Technological knowledge was average to high if at least one of the founders developed the technology themselves or had experience in the technological domain of the venture (cf. Grégoire, Barr & Shepherd, 2010). I coded the prior market knowledge along the same lines. See Table 6 for a summary.

From a learning perspective, the absence of prior market knowledge would be concerning as one might expect less efficient and less successful ventures. Prior market knowledge may reduce information asymmetries on how to serve the articulated needs of consumers, increases understanding of the competitive environment and helps to perceive cues

in case of environmental turbulence or technology change in that industry (e.g. Berg, 2016; Eggers & Song, 2015). Nevertheless, the better performing ventures seemingly did not require the respective market knowledge to decide which field it would enter. The accelerator coach concurred as he noted how SPACE chose a path forward:

> SPACE had technological knowledge about satellites and ground trothing and knowledge from a different market area. What they did in the program is trying to find a new market area. As long as it will be successful and their technology gets out on the market, they don't care which market. (comment accelerator coach on SPACE's choices of market entry)

Notably, the high performing ventures seemed to be engaged with the program on an ongoing basis to take advantage of its resources and cover their lack of prior market knowledge. On the one hand, these ventures likely were looking to the accelerator management team for help in order to better understand the implications of the market information they collected. For instance, the founder of CAPS highlighted in their internal CKIC progress report the benefits of talking to the startup coaches and mentors:

> Discussions with startup coaches and mentors helped to identify the route-to-market challenges and opportunities. This helped us to adapt our interactions with companies and business model. (CAPS, internal document: CKIC progress report Stage III)

In addition, more input has been sought by accessing the broad network of CKIC accelerator to reflect on previous actions in order to inform the next. This corroborates the argument of Sullivan & Marvel (2011) that acquiring knowledge by relying on networks increases venture performance. The accelerator's external network was particularly valued because it enabled the ventures to interact with external partners such as industry experts that helped them deep dive into their initial markets and identify knowledge gaps. For example, the founder of PRINT expressed its gratitude to the CKIC accelerator as "*they gave us a lot of exposure to industry experts who wrote annual industry reports with which we became best buddies"*. To illustrate it with a real-life situation, the founder of SPACE recalled:

> What it did was open up the network. Now, we were trying independently to validate a product against an end user community need but one of the struggles we had was getting in front of them. To really hear from them to what they needed. And CKIC enabled us really to validate those needs with companies that did not speak to us because we had an interesting technology or ideas, they provided some lip service because CKIC asked them to. (SPACE, interview founder)

In contrast, it seems that the presence of prior market knowledge combined with the adoption of the experimental learning approach came at a price of flexibility and instead

resulted in ventures being committed on a single product-market combination. All four ventures, HEAT, SOLAR, MAP, and NEST had relevant market knowledge upon entry and seemed to be primed to only capture certain business ideas related to their prior experience. According to the accelerator coach, they were "*not particular open-minded*" and hereby became less open to experiment with new product-market combinations. They were 'locked-in' on a single product-market combination and fell into a 'knowledge corridor' (cf. Gruber, Macmillan & Thompson, 2013). To illustrate, the founder of SOLAR reflected, one year after graduation from the program, about any changes in their mission or business model and said "*all is still roughly aligned, it is still about bringing affordable electricity in rural areas*".

Although flexibility is stimulated through the lean startup method, it seems that this only underpins the *execution* of opportunities such as testing and improving the business model. For instance, ventures with prior market knowledge were able to adapt quickly to rapidly changing environments but, in general, they were less flexible in the *selection* of new alternatives. The greater focus and the step-wise process of selection and execution of product-market combinations resulted in a lower performance upon graduation, indicated by three acceleration outcomes. Previous research similarly found that ventures who mostly committed to a single (business model) strategy were less successful compared to those who simultaneously conduct (related) business model experiments (e.g. Andries, Debackere & van Looy, 2013; Ott, Eisenhardt & Bingham, 2017).

Furthermore, the results reveal that lower performing ventures were less engaged in the acceleration process. This suggests a variance in how ventures maximize the benefits of being in an accelerator (cf. Hughes et al., 2007; van Weele, van Rijnsoever & Nauta, 2017). More specifically, less performing ventures seemed to be unaware of their needs, reluctant or hesitant to ask for help. For example, the accelerator coach recalled why HEAT wasn't progressing as much as they could have: "*They never asked for a meeting and I worked on the basis that 'they would ask for it if they need it'*". This was surprising as HEAT clearly struggled in Stage I. A frustrated founder of Heat lamented, "*we repeated the stage I ourselves with a different idea to no longer rely on the consumer to make an intelligent rational decision"*. Also, the founder of SOLAR retrospectively wished they would have taken more coaching from the accelerator but admitted that, "*maybe we were also quite a bit ignorant and we did not tolerate a deviation of the execution plan.*" Thus, even though an accelerator program enables ventures to solicit opinions from worthy advisors and coaches, ventures may not always be receptive to third-

party advice (cf. Lefebvre & Redien-Collot, 2013), suggesting that services offered by accelerators are not always effective. Drawing upon the above discussion, I propose:

> *Proposition 3: The effect of participation in an accelerator program on selection flexibility is lower if the venture has high prior market knowledge.*

Please insert Table 5 here

Technology maturity of the solution

Evidence also suggests that the maturity of the technology influenced how the learning path of the ventures under consideration unfolded. More specifically, ventures which base their innovations on existing or newly developed technology (infrastructure), tend to struggle with varying degrees of technology uncertainty. It seems that the more successful ventures i.e. those that exhibited a variance-creating behavior, worked on a solution based on technology with low technology maturity. In contrast, the less successful ventures rather utilized off-the-shelf technologies to create their solution.

I assess the level of technology maturity by observing the technology readiness levels (TRL) each venture based its innovative idea on. This is inspired by the TRL-scale introduced by NASA in the 1970s for complex system developments (Sadin, Povinelli & Rosen, 1989). I also include representative quotes from the interviews (see Table 6 for a summary).

The successful ventures SPACE, GLUE, PRINT and CAPS illustrate. First, these ventures balanced its actions to learn about the market as well as about the core technology. The aim was to both reduce market and technological uncertainty because the capability and performance of a fledgling technology were often poorly understood. As the founder of CAPS reflected:

> It is a big long process to commercialize a new chemical into a product on the shelf that the public will touch. We had to prove that it could work with certain polymers and we had to prove that we could protect that enzyme or encapsulate it. So, a couple of things on the journey that showed the technology could potentially get it to where it needed to go. It was basically de-risking it at every point. But the market needed to have an interest as well. So, we had a lot of market discussions. (CAPS, interview founder)

Second, the approach of the more successful ventures differed from that of less performing ones in terms of how experiments were engineered. In particular, they balanced their resources between the fine-tuning of an application (e.g. adding new features) and the

development of the core technology itself. This was illustrated by the filing of patents and the tensions each venture faced that arose from conflicting demands between improving the application to the point it can be commercialized and testing the core technology to learn more about its use and applicability. These were non-trivial organizational efforts as the founder of SPACE admitted:

> You have got things that are coming down the pipeline and you have got your R&D and you have got resources that needs to be spent on that. And both are important. If you are a small company, you don't have a R&D department. You have a delivery department and those within the delivery department also work on the R&D. And it is how you manage their time. So, it is a balance and that balance is a tricky one to navigate. (SPACE, interview founder)

Furthermore, any change in the product during commercialization can be tied to quite long time horizons and high expenditures when working with emerging technologies. One way of overcoming these constraints, is to creatively leverage a set of collaborators to co-innovate as exemplified in SPACE's action plan upon entry and confirmed by a description by the founder itself:

> Our strategy in CKIC will help to further develop the technology while the commercialization potential is maximized. We will develop generic research capabilities in-house, possibly attracting potential partners to further develop the technology. (SPACE, internal document: CKIC application form)

> We have spent the CKIC money on developing the capability of the product and getting in experts who are able to do things that we weren't able to do. So, somebody came in as a consultant and gave us some really good help on developing the sort of theory behind the product. The supporting finances of CKIC was spent on developing the product alongside the validation activities we were doing within CKIC. Very useful as we were able then to react accordingly and develop our products on the back of that. So, it was the duality of those two elements that were particularly interesting. (SPACE, interview founder)

Another way is to test the technical validity of the solution in the lab in addition to the typical experimentation in the market of interest. For instance, based on archival extracts, both GLUE and CAPS had a research collaboration with an academic institution, respectively, to carry out tests on the use of its resin and to de-risk the technology in regards to toxicity of their chemical. The use of small-scale laboratory experiments to effectively model future product performance resulted in a lower cost per experiment (cf. Pisano, 1996). In their pursuit to reduce technology uncertainty by interacting with co-innovators as well as using a variety of low-cost probes, enabled successful ventures also to strategically select (and execute) new

alternatives in an opportunistic manner. Concepts such as strategic flexibility (Raynor, 2007; Volberda, 1997; Sanchez, 1995) and strategic opportunism in management (Isenberg, 1987) address the question of how to maintain both flexibility to recognize new opportunities and commitment to a certain strategic direction. For instance, PRINT remained its focus on "*transferring the technology out of the lab and develop a standalone Unprinter*" while staying flexible to recognize a new opportunity to develop in parallel a "*fully-integrated module*" in existing printers. As the founder of GLUE reflected, they stroke a balance between strategic focus and opportunism by creatively enacting on opportunities coming their way while being committed to "*stay as a resin-making company*":

> After we were approached through the network of Climate-KIC, one of the other things we got involved with is a European scheme to making door furniture and window frames. If we mixed straw up and have it as a thick liquid, you can either extrude as bioplastic, or put it into a mould and mould it into different shaped objects. (GLUE, interview founder)

In contrast, lower performing ventures based their innovative idea on existing technologies and creatively combined off-the-shelf components to construct the product. The founder of HEAT confidently claimed that they "*weren't afraid for any technology per se*" because to build their solution "*this technology can be as stupid it gets as there is no fundamental science.*" Although they engaged with external partners, the collaborations were only set up in the spirit of testing the application in the field and fine-tuning the solution. They basically seemed to shun away from working with emerging technologies. The founder of SOLAR explained their decision to not choose for "*the more riskier option*" but instead work with technology "*that has a proven track record as the technology isn't a thing we want to fight with at the moment.*" Thus, the learning path is characterized by rapid testing using early prototypes with the intent to innovate incrementally in order to achieve product-market fit. Their efforts within the accelerator mostly focused on learning about the market of interest to analyze the target market and capture customer preferences.

To conclude, the learning path is greatly influenced by the nature of the venture i.e. the prior knowledge of the founders as well as the degree of technology maturity of the product. This can subsequently complicate the intended outcome of an acceleration process which is to get "*a clear focus on the specific market and value proposition that will enable them to raise meaningful external investment*" as emphasized by the accelerator coach (see Figure 3). I therefore suggest:

> *Proposition 4: The effect of participation in an accelerator program on selection flexibility is lower if the venture uses a technology of high maturity.*

DISCUSSION AND IMPLICATIONS

This analysis adds to a growing body of research that illustrates the role of an accelerator in shaping the development trajectory of new ventures. Prior work in the extant incubation literature provides an in-depth understanding about the types of interactions used to support startups and its link to performance (Hackett & Dilts, 2004; Bøllingotft & Ulhøi, 2005; Sullivan & Marvel, 2011). However, it lacks clarity on the underlying process(es) explaining how ventures effectively learn during acceleration. This issue is becoming even more pertinent as the accelerator model is being emulated to support all sorts of ventures, causing some accelerators to hold a more diversified venture portfolio. Questioning the tendency to view accelerators, and more specifically their portfolio ventures, as a homogenous category that is being accelerated equally, this paper explored how an accelerator influences the learning path of ventures that perform differently while taking into account the nature of the ventures.

Theoretical implications

The question whether accelerators impact new venture development is an important question to answer. While emerging studies on accelerators explore this in terms of the acceleration of new venture outcomes and its link to the provided services (e.g. Hallen et al., 2014; Gonzalez-Uribe & Leatherbee, 2017), an equal (if not more) important issue is the lack of qualitative research about how ventures can effectively learn from the services offered by an accelerator. Although prior research established that ventures learn at different rates (e.g. Pisano, Bohmer & Edmondson, 2001), and the overall goal of incubation is to accelerate venture learning (Bruneel et al., 2012; Cohen, 2013) in order to raise new capital, less is known about how ventures maximize the benefits of being in an accelerator and why they experience different acceleration outcomes.

First, I respond to the call in the accelerator research to unpack how certain learning practices drive accelerator effectiveness (e.g. Hochberg, 2016; Hallen, et al., 2014) in terms of helping ventures to raise new capital. By investigating the relationship between the learning path of ventures and the intervention of an accelerator program, this study and its explanatory propositions portray a more nuanced view of how learning occurs in an accelerator and links to venture performance. This may prove critical to broadening my insight into the question why some ventures experience different acceleration outcomes. In particular, this study finds not only that an accelerator intervention shapes the learning path of ventures by stimulating them to engage in an experimental learning approach. A striking finding is that the learning

paths of ventures overlap to a certain extent in their market engagement approach by 'getting out of the building', however, the way those learnings are subsequently transformed in actions varies. The differences in learning behavior depend on venture characteristics such as prior market knowledge and technology maturity of the technological solution. This, in turn, impacts venture performance and implies that the effectiveness of an accelerator can vary according to the learning behavior of the ventures.

Second, I adopt a learning and experimentation view of acceleration to explain the variance in acceleration outcomes and how it relates to learning. My argument is based on the notion that accelerated ventures choose, whether deliberately or otherwise, to behave in ways that enable them to simultaneously seize alternative technological ideas or remain focused and develop deep market knowledge on a specific product-market combination. Since the accelerator phenomenon has been described as "*a great example of the power of the Lean Startup approach to entrepreneurship*" by Brad Feld, founder of Techstars, some ventures in my sample indeed tried to engage in a sequential process of experimental learning as prescribed by the lean startup method (Blank & Dorf, 2012; Ries, 2011). This can also be described as a mean-enhancing strategy (cf. McGrath, 2001) which promotes execution flexibility but impedes opportunism such that ventures commit to find the winning combination of technology, market and business model in an incremental and efficient manner. Unfortunately, the consecutive manner of fine-tuning components in the business model and focusing on one product-market combination at a time, did not pay off for most ventures. Venture development was thwarted and as a result, none of the firms that engaged in sequential experimental learning during my study performed well.

In contrast, other ventures explored (related) alternatives steered by marked feedback in the accelerator program. Unlike the sequential experimenting ventures, these ventures avoided to test one business model at a time, but instead, pursued a coherent strategy by running multidimensional business models that could be useful. This form of experimentation that I labelled "parallel" appeared to support or even drive venture development. Although these ventures struggled with the additional complexity, they were successful in attracting venture capital investment as they developed multiple applications in major markets and with the potential to capture value from entirely new markets. Specifically, the findings reveal that the combination of drawing extensively from an accelerator's network to involve a set of collaborators and relying on a wide variety of low-cost probes, offset the increased uncertainty of pursuing different options and likely increases venture performance. The latter finding extends Brown & Eisenhardt's argument that probing with a wide variety of (low-cost)

experiments seems to not only enhance learning and success for business units in publicly held computer firms (Brown & Eisenhardt, 1997) but also for entrepreneurial ventures.

My findings also add insights to our understanding of the paradoxical tension between focus and flexibility in the context of early-stage ventures. Previous work arguments against any opportunistic decision making in terms of selecting new business opportunities and promotes actions that sequence multiple opportunities by stringing them together (Bingham, Furr & Nathan, 2014; Bingham, 2009), though this need not always be the case. When risks are mitigated by e.g. developing partnerships and securing pre-commitments from various stakeholders, multiple opportunities can be selected and executed in parallel. In fact, learning from opportunistic activities such as creating new product-market combinations seems to be a critical part of the development of early-stage ventures (cf. Murray & Tripsas, 2004) as it creates a portfolio of (growth) options.

My findings further refine previous arguments in favor of experimentation in new ventures (e.g. Maine & Garnsey, 2006; Lubik & Garnsey, 2016; Maine, Lubik & Garnsey, 2012) by putting it in the context of acceleration. They show that new ventures, especially science-based ventures, benefit from experimentation in various markets as a means of spreading market risk. However, any derived performance benefit depends heavily on available resources as well as any partners involved. An accelerator provides just that.

Furthermore, this study helps to answer questions about the consequences of lean startup methodology. Overall, the lean startup method claims to create 'radically successful businesses' as it promises time-to-market reduction and reduction of market uncertainty. Although the use of lean principles becomes more widely spread, its applicability seems to be bounded by steering a venture's focus toward actions that mitigate market risk. But what if ventures face a great deal of both market and technology uncertainty? This would render the reduction of market uncertainty extremely difficult because assumptions not only revolve around the markets but also on the use and capability of the technology. For instance, ventures deeply immersed in science face quite considerable technology-market ambiguity and are limited in their ability to prototype and rapidly build products in an iterative and interactive manner (Pisano, 2010; Lubik & Garnsey, 2016). My findings suggest that the lean startup approach can be a double-edged sword in heterogeneous venture portfolios of accelerators. While, ventures could turn to consecutive tests and incrementally fine-tune the solution to achieve product-market fit, adhering to a sequential experimental approach can significantly increase the commitment to a course of action hereby limiting their chances to select better alternative product-market combinations. In other words, an accelerator program should be

designed in such a way that it instills flexibility in opportunity selection while minimizing the risks in opportunity execution.

Third, this study adds to a recent stream of research that illustrates the role of organizational context in shaping the approach to commercialization processes (Grimaldi, Kenney, Siegel & Wright, 2011; Nelson, 2014). By integrating learning milestones in the program that stipulate the basic elements of the lean startup method, admitted ventures are inclined to engage in experimentation that emphasizes learning from experience. At the same time, my results imply that the learning path of each venture might not be as malleable as some would hope or believe because both the features of the venture and the accelerator drive the learning approach. In fact, this makes it difficult to devise a "one size fits all" acceleration model.

Managerial and policy implications

Answering my research question expands our understanding of acceleration because many start to mimic the standard set by the likes of Y Combinator and Techstars with the aim to support new ventures that are in different stages and active in all sorts of industries. By showing that the learning paths of a set of ventures are differently impacted by the accelerator program, it supports my notion that the role of accelerators as a 'high throughput' tool should be revised. More specifically, the perception of a "one size fits all" approach championed by organizations such as the Global Accelerator Network assumes that acceleration is a way to launch new ventures on rapid learning trajectories in a controlled manner. However, this may fall short for those ventures that aren't developing typical software and mobile products and aren't mainly focusing on the market adoption issue. Combined with the ultimate goal to have a greater impact on a venture development trajectory, more customized models are recommended to meet the specific needs of each venture (cf. Goswami et al., 2017; Roberts et al., 2017).

Furthermore, as the success of an accelerator typically hinges on the performance of its admitted ventures, a deeper understanding about whether acceleration differentially impacts the learning of ventures benefits accelerator managers to make informed decisions in their selection and the overall design of the program. In the case of CKIC accelerator, ventures trying to commercialize a newly developed technology are enabled to explore alternatives and search for (related) applications beyond their initial choice because of the flexibility of the program. In contrast, a traditional accelerator using a very short time frame (e.g. 3-4 months), most likely would narrow the venture scope which might have an adverse effect.

Limitations and future research directions

This study has two main limitations that I encourage future studies to address.

First, my data is limited by its sources as well as retrospective biases. My use of internal progress reports, media coverage such as twitter data and other secondary news sources provides us a way around some of the problems inherent in using entrepreneur's reflections. Even though my archival work is extensive and from a multitude of perspectives, my findings are tentative. In addition, I chose a small sample to allow rich examination of learning paths and their potential causes and consequences. However, while this choice increases the likelihood that findings will be fresh and internally valid, it does so at the expense of generalizability and external validity. This calls for more comprehensive and large-scale empirical research in order to develop a process model that looks at the "regularities in temporal patterns across cases" rather than seeking explanations for variance in outcomes (Langley & Abdallah, 2011:13).

Second, caution must be taken in the interpretation of my results concerning the relationship between the nature of a venture, an accelerator's learning environment, and venture performance. As the success of accelerators relies on a complex combination of venture characteristics such as human capital and various elements of the program, I call for more research utilizing a comparative design whereby learning paths of ventures are analyzed and compared with those from another (differently designed) accelerator program. For instance, additional work is needed to explore the role of ventures' attitudes toward advice (e.g. Grimes, 2017). Considering mentoring and networking are the core activities of an accelerator, research on behavioral decision making and the possible discount of third-party feedback by founders would provide more insight into the question of why accelerating ventures experience different program outcomes.

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FIGURES AND TABLES

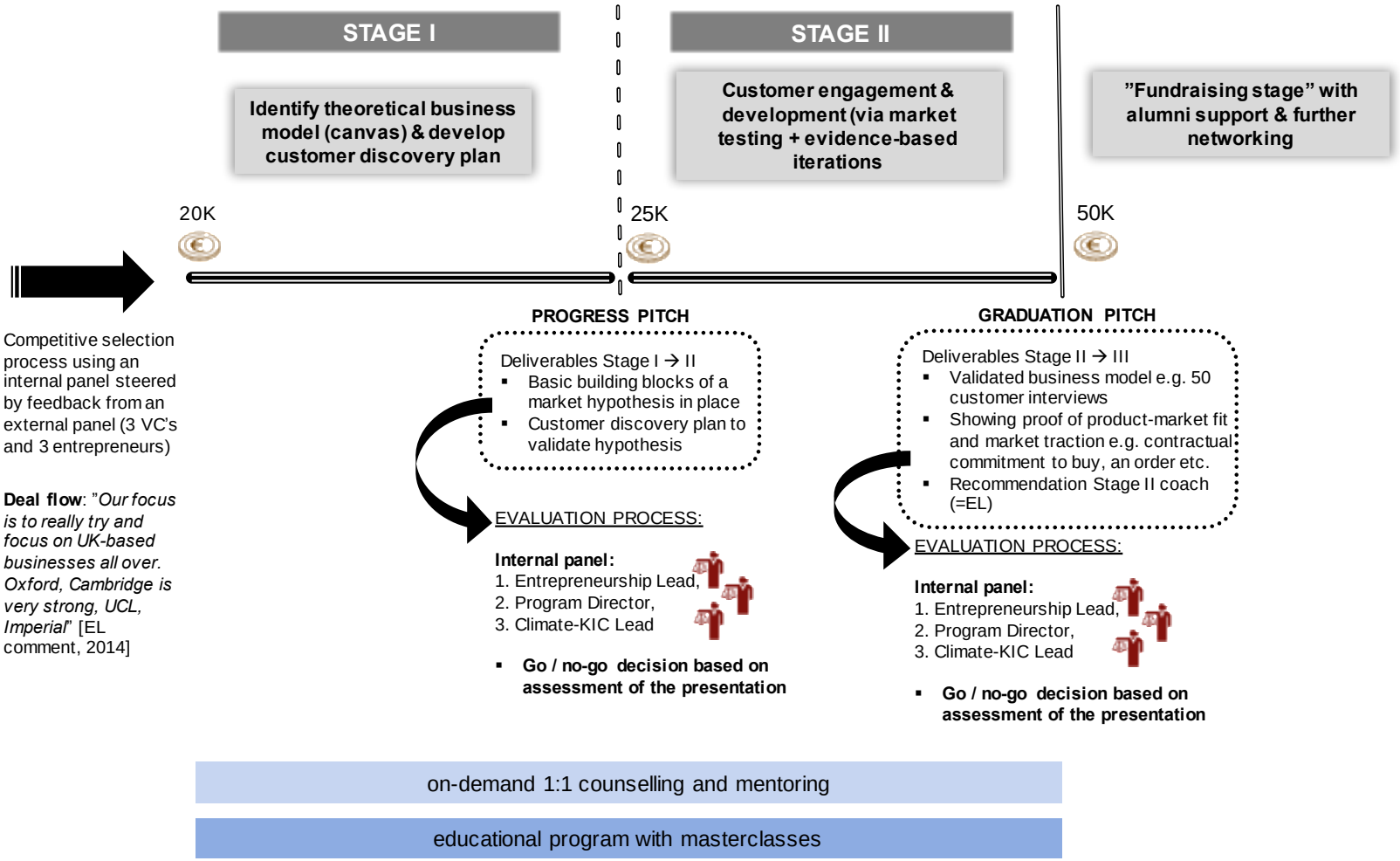
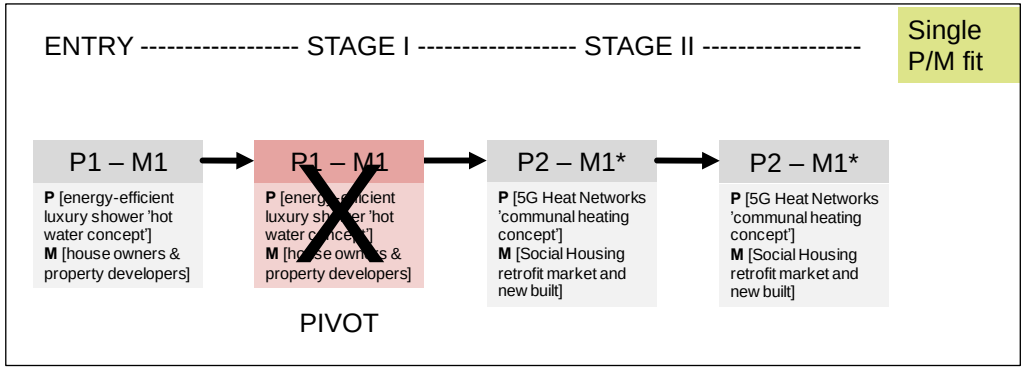


Figure 1. Accelerator treatment

[A]



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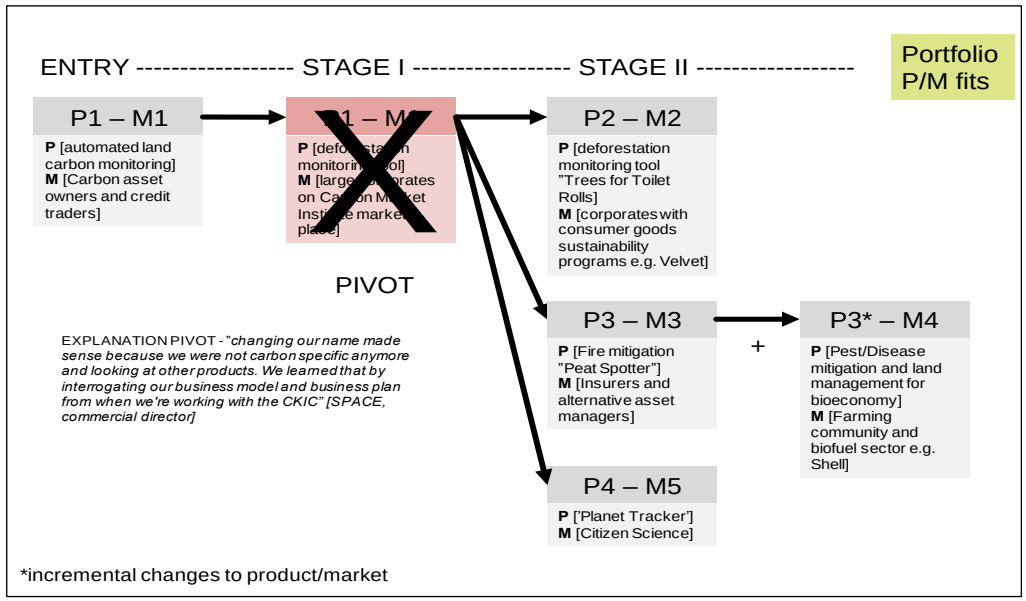


Figure 2. Example learning path of [A] HEAT and [B] SPACE

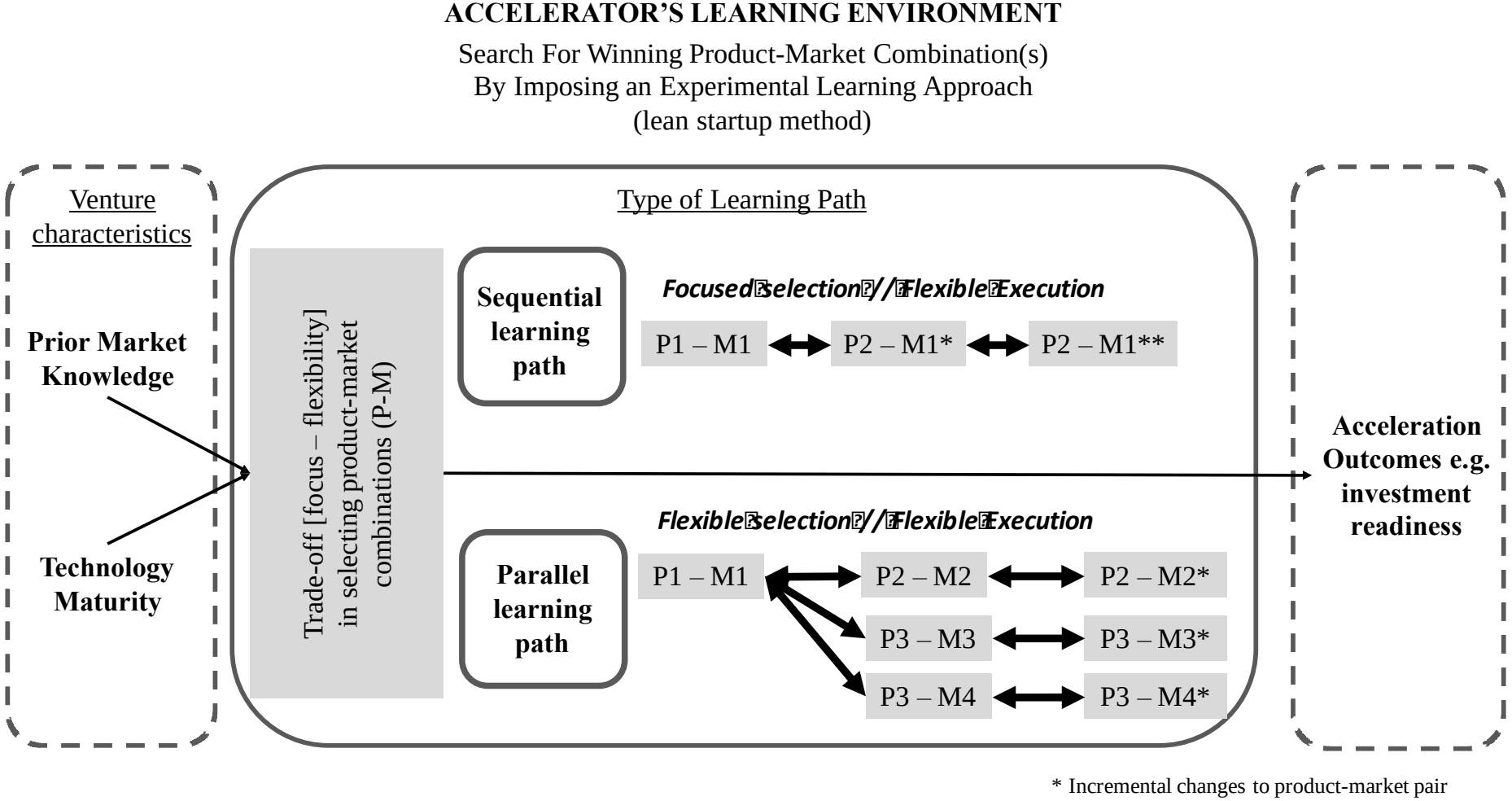


Figure 3. A holistic view of how the learning paths of admitted ventures unfold and relate to acceleration outcomes by zooming in on the selection and execution of product-market combinations (P-M).

Table 1. Dimensions of accelerator treatment relevant to the learning path of participating ventures

Dimensions	Definitions	Exemplary quotes
MENTORING AND COUNSELLING	The provision of rapid feedback and know-how about how to seize opportunities through mentorship and counselling. The aim is to resolve demand uncertainty when discovering and/or evaluating opportunities	Discussions with mentors helped to identify route-to-market challenges and opportunities, helping us to adapt our interactions with companies and business model (CAPS, founder) CKIC accelerator has also provided invaluable mentoring and guidance for us, supporting our drive to accelerate growth over the last six months. (SPACE, founder)
EDUCATIONAL PROGRAM	Schooling services in the form of an educational subprogram comprised of workshops on topics like negotiation skills, pitching, business model canvas etc.	The most amazing thing was the access to the masterclasses. It wasn't just any masterclass… the gurus of the startup scene were flown in to coach us. They gave us an insane amount of guidance which gave us the ability to make changes over and over again (MAP, founder) The broad gamma of masterclasses offered by the CKIC accelerator. Tbese sessions were of so high quality compared to what I have seen in other accelerators. Other accelerators are more like screwing around with it, while CKIC invited the experts. That is very smart of them. (PRINT, founder)
NETWORKING AND VALUE CERTIFICATION	Mechanisms to tackle lack of legitimacy and established network so early-stage ventures can attract resources such as joint development of a trial with a corporate or extra investment	We were introduced to some customers. Customers but also partners who were prepared to really engage in the development of the product… Finding partners effectively was the biggest enabler." [HEAT, founder] The accelerator had a big network in the context of large companies that were interested in the use of software technologies in the cleantech space… to try align ourselves with the people in the industry who did know what existed and what did not (SPACE, founder) CKIC accelerator's support has been invaluable in getting access to the right people at the EU and national levels. Before the program, we were just a few guys from Cyprus and The Netherlands. Now they take us seriously. (MAP, founder)
FINANCIAL RESOURCES	Sponsoring in the form of an equity-free grant to enable participating venture exploit their innovative ideas	To be able to open up the small pots of money that help you to get the experts you need… the actual cash in those early stages was just perfect for a company of our size and state at that point (CAPS, founder) The hard cash on day one. Then we could finally do something. Because we were a hardware business and we had to build something. We also hired a CTO with that money. (PRINT, founder)
LEARNING MILESTONES	A disciplined systematic approach to hold portfolio ventures accountable in achieving their goals. Flexible learning milestones were integrated linked to a financial incentive	This exercise of business modelling and validation, we wouldn't have otherwise done. We were really forcing ourselves to go out into the market place, and speak to clients (SPACE, founder). I think that the fact you have to jump over things, is a good thing. And also, some companies are not going to do it. You know, they are not going to do it, because they have a technology that doesn't work or they get things not going. (GLUE, founder)

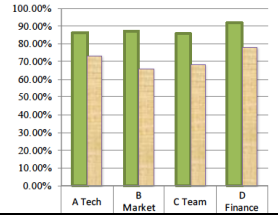
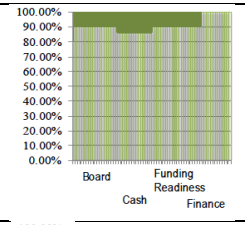
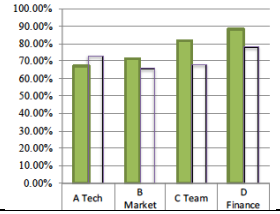
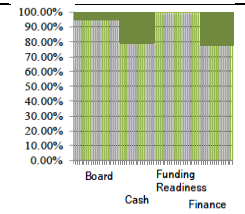
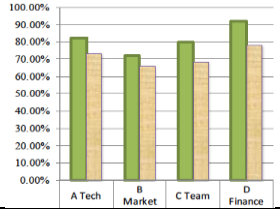
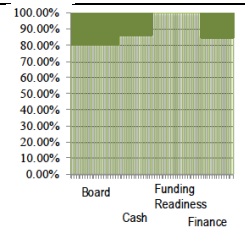
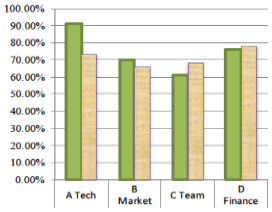
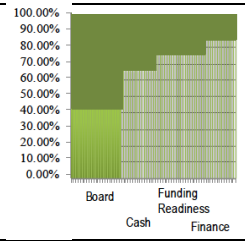
Table 2. Sample of technology ventures

	Technology	Value proposition	Year of Incorporation	Year of admission	Key Informants	Status
1. CAPS	Aqeous dynamic orthogonal technology - combining simple fabrication and quantitative loading of a wide variety of encapsulated materials with a modular building method	Encapsulation platform technology for use in the microencapsulation industry	Aug. 2012	Jan. 2013	Founder and inventor	Active
2. GLUE	Pioneering process based on Biomass Crosslinking and Blocking technology to form a water resistant polymeric network using biomass such as algae and Distiller's Dry Grains and Solubles (DDGS)	Industrial low-carbon bio-adhesive based on biomass feedstocks	Jan. 2014	Nov. 2014	Founder and ideator	Active
3. HEAT	Pairing heat pipes with home sensors (IoT) and advanced algorithms for thermal storage and load management	Smart 5G heat networks for retrofit and new building housing, which are simpler, more reliable, more efficient, and more affordable than installing individual boilers in every home.	May 2013	May 2013	Founder and inventor	Failed
4. MAP	Cloud application with algorithmic analysis of energy perf.	Database and online platform of building's energy performance certificates	Jan. 2013	Jan. 2013	Founder and ideator	Active
5. NEST	Online web tool which integrates building energy analytics	Energy monitoring and management software - combining behavioural science with energy analytics to help organizations and households understand and manage their energy use	Sept. 2011	Sept. 2012	Founder and ideator	Active
6. SOLAR	Off-grid renewable solar generation and distribution technology	Innovative, cost-effective and mass deployable micro generation grids for rural electrification	May 2012	March 2013	Founder	Active
7. SPACE	Earth Observation (EO) imagery gathered by satellite and ground trothing - statistical analysis of EO and satellite data on a single dedicated platform using Geospatial Informatic Systems	Provider of data-as-a-service geospatial data analytics - GIS application for landscape intelligence from earth observation and remote sensing data	Feb. 2012	Feb. 2013	Founder	Active
8. PRINT	Laser-ablation technology with long and ultrashort pulsed lasers	Unprinting laser printed paper to remove the toner so the paper can be reused	Jan. 2014	May 2014	Founder	Inactive; sold IP portfolio to private firm

Table 3. Sources of Information and Type and Amount of Data Obtained

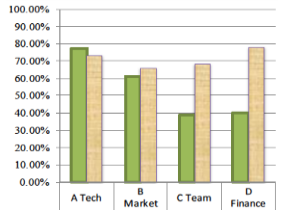
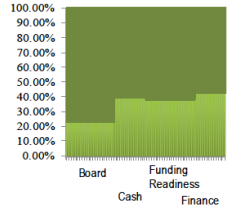
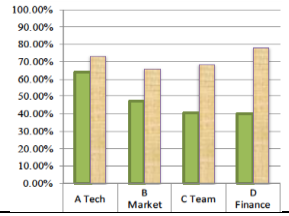
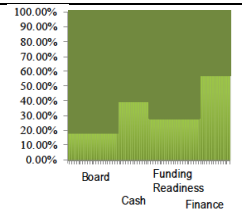
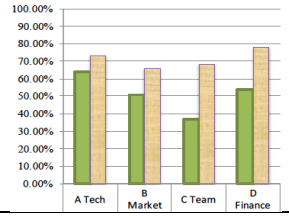
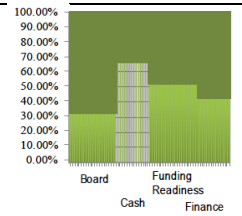
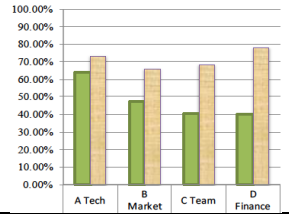
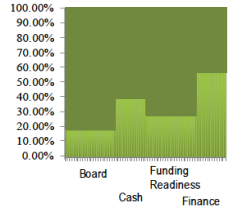
	HEAT	MAP	SOLAR	NEST	GLUE	SPACE	PRINT	CAPS	CKIC Acc.
# Interviews	1	1	1	2	3	2	1	2	12
Respondents	Lead founder	Lead founder	Lead founder	Lead founder	Lead founder	Lead founder	Lead founder	Lead founder	Accelerator coach
Length interviews (min.)	67	41	48	121	155	114	38	86	726
# Press releases and coverage	11	16	18	18	16	36	21	29	/
# Formal company documents - grant proposals, pitch decks, conference presentations, internal reports	4 pitch decks, 3 presentations, 1 grant proposal	/	1 pitch deck, 1 internal report	1 grant proposal, 2 internal reports	2 pitch decks, patent data	1 business plan, 2 internal reports, 1 pitch deck	patent data, 2 grant proposals	patent data	8 internal documents on performance
Publicly available real-time info (LinkedIn, website blogs, YouTube, social media such as facebook and Twitter)	LinkedIn profiles, 2 websites, Twitter feed May 2013 - Dec 2016	LinkedIn profiles, website history, 3 YouTube videos, Twitter feed April 2013 - Dec 2016)	LinkedIn profiles, website, 3 YouTube videos, facebook posts, Twitter feed May 2013 - Dec 2016	LinkedIn profiles, 51 website blog posts, Twitter feed Dec 2009 - Dec 2016	LinkedIn profiles, Twitter feed April 2014 - Dec 2016	LinkedIn profiles, 26 website blog posts, 6 YouTube videos, Twitter feed Feb 2013 - Dec 2016)	LinkedIn profiles, 4 YouTube videos, Twitter feed Aug 2014 - Dec 2016	LinkedIn profiles, 14 website blog posts, 4 YouTube videos, Twitter feed Oct 2012 - Dec 2016	8 official pitch decks and 1 video description
Internal documents provided to accelerator program	Application Form CKIC progress report Stage I + expenditure CKIC progress report Stage II + expenditure CKIC post-graduation report Stage III + expenditure	Application Form CKIC progress report Stage I + expenditure CKIC progress report Stage II + expenditure CKIC post-graduation report Stage III + expenditure	Application Form CKIC progress report Stage I + expenditure CKIC progress report Stage II + expenditure CKIC post-graduation report Stage III + expenditure	Application Form CKIC progress report Stage I + expenditure CKIC progress report Stage II + expenditure CKIC post-graduation report Stage III + expenditure	Application Form CKIC progress report Stage I + expenditure CKIC progress report Stage II + expenditure CKIC post-graduation report Stage III	Application Form 2 CKIC progress reports Stage I CKIC progress report Stage II CKIC post-graduation report Stage III + expenditure	Application Form CKIC progress report Stage I + expenditure CKIC progress report Stage II + expenditure expenditure	Application Form Entered directly in Stage II CKIC progress report Stage II + expenditure CKIC post-graduation report Stage III + expenditure	All assessment forms – subjective/objective qualitative and quantitative performance measurement of ventures

Table 4. Effectiveness of acceleration process measured as venture performance outcome

FIRM	*OVERALL*	IP development	Speed of Acceleration Process (in months)	Outcomes Fund Raising[b] (12 months after graduation)	Venture Benchmark Against 'Golden Standard'[c]	Investor readiness[c]
SPACE	HIGH	"*IP has been captured as software*"	11	Raised £700k for 20% equity through equity crowdfunding (Investing Zone)		
PRINT	HIGH	2	5	Raised £500k from Cambridge Enterprise		
CAPS	HIGH	1	12	Raised first & second funding round [total of £3.926M] by Imperial Innovations, Cambridge Enterprise, Parkwalk Advisors, and Providence Investment Company		
GLUE	HIGH	filed 2 patents in same year of application to CKIC	8	Raised £1.5Mk for Chinese Joint venture with Changzhou Kangtian New Material Technology		

[a] source: ranking by accelerator coach // [b] source: publicly available data // [c] sources: subjectively measured by the accelerator management team upon graduation.

Table 4 (continued)

FIRM	*OVERALL*	IP development	Speed of Acceleration Process (in months)	Outcomes fund raising[b] (12 months after graduation)	Venture Benchmark Against 'Golden Standard'[c]	Investor readiness[c]
SOLAR	MODERATE	/	15	/		
MAP	MODERATE	/	19	/		
HEAT	LOW	/	20	/		
NEST	LOW	/	17	/		

[a] source: ranking by accelerator coach // [b] source: publicly available data // [c] sources: subjectively measured by the accelerator management team upon graduation.

Table 5. Representative data of learning actions and outcomes of the lean experimental learning approach

Successful Ventures	Actions based on Lean Startup Principles	Representative Quotes
SPACE, GLUE, PRINT and CAPS	Business Model Processing	*We were putting together our business model, and we went through the canvas exercise with the Climate KIC, over quite a long period of time* [SPACE, interview founder] Clarifying the business model with a UK commercial partner will be a key objective for our Phase II activities. [GLUE, extract internal document - CKIC Progress Report Stage I] CHANGE IN APPLICATION - *When we started on our journey in CKIC, we also thought to build a super big unprinter, doesn't matter how much it would cost, and it could unprint 100 pages very fast somewhere on industrial grounds. We would become a paper shop.* [PRINT, interview fouder] CHANGE IN APPLICATION AND CASH FLOW FORMULA - So we have been going down that road of trying to develop a licensing agreement to bring in the cash. But we also got some new winning applications as well so there are the ones where we will do some nice manufacturing & sales to bring in some early revenues. So, it is gone from licensing to bit of a hybrid. [CAPS, interview founder]
	Getting Out Of The Building	*We carried out, quite a lot of interviews, with people that ultimately we might want to work with. We were really forcing ourselves to go out into the market place, and speak to clients.* [SPACE, interview founder] *The business really has been driven by contact by the market place and some people say yes and some people say no. And we push the people who say yes rather than trying again and again with people who say no.We also find that when we engage with customers, the way we are thinking is not going to work because they are quite blunt in telling us. They want this, they want that, they don't want something else and if you can't deliver, forget about it, go away.* [GLUE, interview founder] *Get out of the building, that whole concept is super important. We interviewed a lot of people that buy printers, and those that produce them. It is a non-stop journey.* [PRINT, interview founder] *A whole bunch of searching. Who is doing something with microencapsulation, what are their challenges? It was just searching and then talking to the people that knew. So asking a lot of questions.* [CAPS, interview founder]
	Agile Engineering	*We could quickly move solutions around our technology, prototype it, get it tested in the market and start sell it.* [SPACE, interview founder] We have made progress in our pilot development work, we have used the success of the trials to develop our business strategy and address several markets. [GLUE, extract internal document - CKIC Progress Report Stage I] *To further develop our unprinter, the co-founder went out and tested dozens of lasers in different types of technology formats.* [PRINT, interview founder] *CKIC forced the company and the people involved in it to develop a prototype or a product that they have to sell in a very short time frame. It focuses the mind into a more commercial company.* [CAPS, founder interview]

Table 5. (continued)

Less successful Ventures	Actions Based on Lean Startup Principles	Representative Quotes
HEAT, SOLAR, MAP and NEST	Business Model Processing	PIVOT IN PRODUCT CONCEPT - Cambridge Heat Transfer began 2014 exploring efficient, cost effective, domestic hot water systems for modern low energy buildings. We developed an efficient, packaged, solution for providing hot water in the bathroom: a bathroom appliance designed for volume manufacture and a low installed cost. New build developers and social housing retrofit were the target markets. Unfortunately, bar the green building niche, our target market had other ideas. Given the niche buyin for our hot water concept we elected to focus our efforts on the communal heating solutions that were popular with our target market instead: the pivot. [HEAT, extract from internal document - CKIC Progress Report Stage I] CHANGE IN APPLICATION - From the lessons learned in India, we are now integrating phone chargers in each lighting unit. Also, we are migrating from the 500mm fluorescent light fittings to high-efficiency LED lights. [SOLAR, extract from internal document - CKIC Progress Report Stage I] *We had validated from seven changes, we circled around what the different customers could be… we went to all sorts of different entities. We constantly pivoted figuring out what is Enermap going to look like in order to create value.* [MAP, interview founder] *They modified their revenue model, their revenue streams. So what we can see is that the sharp focus on the customer segment then helped them to refine their product and service offering to more precisely meet the customer need.* [NEST, comment accelerator coach on progress of venture]
	Getting Out Of The Building	*You have to go on the scene to understand what you are talking about.* [HEAT, interview founder] It was important to us to get early feedback from our customers. [SOLAR, extract from internal document - CKIC Progress Report Stage I] *We cracked the puzzle and figured out the way how Enermap was going to produce value. We had early validation from customers who said 'you know yes I need it' and we validated why they needed it.* [MAP, interview founder] *We realized that the pain point for a small medium sized businesses and households is not strong enough that they will be willing to pay. And what we realized as well is that these bigger companies which I thought have it all figured out. They did not so our confidence grew the more I was networking in the market.* [NEST, interview founder]
	Agile Engineering	We will also use active load management (smart grid techniques) to reduce peak loads on the network and enable use of yet smaller pipework for a given application. We will also use additional loss reduction techniques, such as demand forecasting and purging pipework of hot water when demand is unlikely. [HEAT, extract from internal document - CKIC Progress Report Stage I] With a to-do list of improvements, we started to iterate each electrical component of the MeshGrid into its second revision with improved reliability mechanical design. [SOLAR, extract from internal document - CKIC Progress Report Stage I] Sprinting for MVP development & customers. Examples of actions are the development of 3 new MVP's and called 50 energy retrofitters and auditors in UK. [MAP, extract from internal document - CKIC Progress Report Stage II] *We used the funding to follow a more leaner approach and did testing and prototyping to figure out what the bugs were and the problems with the kind of basic code.* [NEST, founder interview]

Table 6. Representative data about venture characteristics such as prior market knowledge and technology maturity linked to each venture's innovative idea

FIRM	Prior Knowledge	Technology Readiness Levels (TRL)	Representative Quotes
SPACE	High technological knowledge // Low market knowledge	TRL < 6 (use of new tech)	*There was nobody else out there offering the same thing in terms of technology, hence why Innovate UK was prepared to fund it before we entered CKIC* [founder interview]
PRINT	High technological knowledge // Low market knowledge	TRL < 6 (use of new tech)	*We discovered CKIC because we were searching for expertise as we both did not have any experience in bringing a technological idea from the lab into the real-world* [founder interview]
CAPS	High technological knowledge // Low market knowledge	TRL < 6 (use of new tech)	Caps's proprietary technology will distinguish itself from other competitors with higher capsule loadings, milder conditions for processing to help our customers reduce CO2 emissions, and provide cost savings in manufacturing and raw materials [description of value proposition in internal document - CKIC Application Form]
			We look forward to creating early value with this disruptive and novel technology through a number of partnerships in different industry segments. [quote founder on CAPS website blog]
GLUE	High technological knowledge // Low market knowledge	TRL < 6 (use of new tech)	Our approach represents a significant new development in the means of manufacturing a key industrial commodity [description of value proposition in internal document - CKIC Application Form]
SOLAR	High technological knowledge // High market knowledge	TRL > 6 (use of existing tech)	*What we are doing is not rocket science. What we are taking is existing technologies and combining them in a new way to be able to address a particular problem or market.* [founder interview]
			When they first came in to stage I, they had a really rough prototype and they had a sort of cage which had the electronics in. So they kind of put it all together and it worked but it was really rough. [comment entrepreneurship lead]
MAP	Moderate technological knowledge // Moderate market knowledge	TRL > 6 (use of existing tech)	*Our case it is not a technological breakthrough like a typical cleantech startup or hardware technology.* [founder interview]
HEAT	High technological knowledge // Moderate market knowledge	TRL > 6 (use of existing tech)	*We weren't afraid for any technology per se. Building this technology can be as stupid as they get... there is no fundamental science, there is nothing super in-depth.* [founder interview]
NEST	High technological knowledge // Moderate market knowledge	TRL > 6 (use of existing tech)	*They had come out of Oxford University with some really good algorithms that measured energy consumption. They had a great UI but their concept was a piece of technology* [comment entrepreneurship lead]
			We are different to some of the Climate-KIC startups. In a way, ours was not… we did not have these technology risks and unknowns and uncertainties around the technology [founder interview]

APPENDIX A: Effectiveness of the acceleration process

To measure the effectiveness of the acceleration process, I used both qualitative and quantitative indicators obtained from multiple data sources and at different points in time. First, I assessed the speed of acceleration defined as the elapsed calendar time (in months) each venture needed to reach the requirements of the two distant learning milestones in the program.

Second, a venture's investor readiness has been subjectively measured by the accelerator management team upon graduation. This score reflects the ability of a venture to attract significant external investor funding from venture capital funds and/or business angels (cf. Douglas & Shepherd, 2010). This is based on 45 questions directly related to the funding readiness of a venture. The questions concerned matters such as the development of a (advisory) board and funding roadmap. In addition, each venture has been benchmarked against a 'golden standard'. This score was based on the performance of 20 successful cleantech ventures and then averaged.

Third, I assessed the outcome of the acceleration process 12 months after the graduation which forms a post-hoc measure to triangulate the subjective scores of the accelerator management team on investor readiness. Prior research recognizes that effective acceleration processes likely yield in higher speed to reach key milestones such as raising venture capital and gaining customer traction (Hathaway, 2016; Hallen, et al., 2014; Gonzalez-Uribe & Leatherbee, 2017). I thus gathered the outcome data by identifying successful fundraising events.

APPENDIX B: Interview Protocols

<u>Interview Protocol 1</u>

1. How did you come up with the initial concept and what made you decide to pursue it?
    - *A reply can (partially) provide information about the technical / market knowledge*

2. When developing the business, how did you come to realize that the business and the underlying business model would need to change? In other words, how did you realize the problems or limitations of the initial concept (e.g. their technology / knowledge / values)
    - What was the context like?

3. How did you go about searching for and identifying alternatives?
    - Which practices did you adopt?
    - Which criteria did you adopt?
    - How did you experience the need to change your beliefs?
    - Did you acquire new knowledge and practical capabilities?

4. How did you evaluated the alternatives? How and why did you decide to select and develop one of these alternatives?
    - Which practices did you adopt?
    - Which criteria did you adopt? (*affordable loss heuristic)*
    - How did you experience the need to change your beliefs?
    - Did you acquire new knowledge and practical capabilities?

5. Can you explain which main hurdles you encountered during this change process and which main key elements made it easier for you?
    - *Allow respondent to speak. Only probe for presence of IP, the perceived degree of change, time-wise, context, AFTER the respondent has finished answering*.

6. How did any external parties or entities (investors, mentors, support programs) influenced this whole process i.e. from the realization change was required, to identification of a new concept(s), to the decision and execution of developing a new concept?

7. Were there any other changes you implement to the business model?

Interview Protocol 2

1. Could you explain what the deliverables were during the Climate-KIC and how this influenced your actions (more focused on the market or technology)?

2. Upon entering Climate-KIC, how confident were you about the ability of the technology in solving the problem you've identified?

3. What were your key activities? Were you more trying to understand the problem in the market or continue the development and testing of your technology? Could you also provide examples?

4. What did you have to do still on the technology side and how was this related to your learning about the market?

5. Did Climate-KIC help you along with that?

6. Would you have done things differently? For instance, would you have changed the focus of your activities and the order in which you did them?

7. What is the time that you would have needed for certain activities compared to the time you have spent on it during the CKIC program?

8. Do you believe that the speed of firm growth would have been similar if you weren't part of the Climate-KIC program? In other words, did acceleration take place

9. Until what time were you still making use of the Climate-KIC support once in Stage III?

10. What is your current situation and how instrumental were the learnings gathered throughout the program regarding the further development of your venture?